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Moscow. Nauchno-Issledovatel'skii Institut Kartofel'nogo Khoziaistva. Semenovodstvo i aprobatsiia kartofelia (Production and certification of seed potatoes) Moskva, 1946. 207 p. 75 M858

Translated in part by
S. N. Monson

INTRODUCTION

The work on the "Production and Certification of Potatoes" is published upon the suggestion of the Department of Agriculture of the RSFSR and is designed to serve as a handbook on the seed growing and certification ("aprobatsia") of potatoes for the benefit of the agronomists of land organizations, collective and state farms, and affiliated organs.

The book provides leading and instructive material on the proper organization of seed growing of potatoes in conformance with the decree No. 1620 of the Soviet of Peoples Commissars of the USSR, dated November 25, 1944, under the heading "On Improving Potato Seed Growing", and it relates to problems of seed growing, varietal work, the storage of seed material and the methods of controlling diseases and potato pests.

It represents the work of several staff members of the Institute of Potato Industry. The respective chapters were contributed by:

1. M. M. Maximovich - "Growing Seed Potatoes"
2. N. D. Zaitseva - "Description of potato varieties and methods for their determination"
3. O. P. Chernishova, Sr. staff member and L. P. Rozhalin - "Diseases and pests of potatoes and methods for controlling them"
4. D. I. Zhukovsky, Sr. staff member - "Potato Storing"

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Zaitseva, N.D.
R-55

Moscow. Nauchno-Issledovatel'skii Institut Kartofel'nogo Khoziaistva. Semenovodstvo i aprobatsiia kartofelia (Production and certification of seed potatoes) Moskva, 1946. 207 p. 75 M858

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CHAPTER II - DESCRIPTION AND ECONOMIC CHARACTERISTICS OF REGIONALIZED POTATO VARIETIES. p. 60-62

Regionalization of Potato Varieties

The availability of numerous varieties of potatoes, differing extensively from each other in their economic qualities, their demands upon soil, climate, etc., compel one to approach the matter of selection of varieties for the different regions and farming sections with the greatest caution.

As new varieties are produced, studied under conditions of production at collective and state farms, the matter of recommending varieties for specific regions and farm lands becomes a still more responsible task. As a general rule it is necessary to take into account that there are no varieties that give equally good results under all ecological conditions.

In order to establish the suitability of a variety for a concrete enviroment it has to be tested. Only the experimentation of a new variety under conditions of production in some region or other, when compared with a control variety, (the best varieties in local conditions), will demonstrate its suitability under prevailing conditions.

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This work is being performed by the Government network of Varietal Testing (Gossortset') on specially organized varietal plots of which there are several in each oblast, territory and republic and which take in the most important soil-climatic changes in conditions in the respective areas. Depending upon the results of the tests performed at the Varietal testing plots of the Gossortset' some varieties are rejected as unsuitable, others are accepted for introduction into collective-state farm production.

The varieties receiving favorable appraisal by the Government Commission on Varietal Testing are included into the list of recommended varieties for a given oblast, territory or republic. On the basis of the data obtained from the testing of varieties at collective farms of the different regions by local land organizations, a distribution of varieties within each oblast is made to serve the latter's regions and collective farms. Of all varieties possessed by the USSR (over 1000), of foreign and domestic selection, fifty (50) varieties have been segregated and regionalized for territories, oblasts and republics as a result of their respective studies at the Institute of Potato Industry.

Two tables attached (appendix 3 and 4) at the end of this volume refer to the regionalizing of potato varieties. Appendix 3 refers to the distribution of varieties in the RSFSR, as established by the Gov't Commission on Varietal Testing in 1942. Appendix 4 lists the distribution of varieties in the remaining republics of the USSR, exclusive

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of Bessarabia, the oblasts of the Western Ukraine and Western White Russia, and the Latvian, Esthonian and Lithuanian republics, as of April 1, 1945.

The varieties receiving the widest distribution at the present time may eventually be replaced by more valuable varieties in the order in which the latter new varieties are produced.

All varieties are divided into three groups according to speed of ripening: RAPID MATURING, MEDIUM MATURING, AND LATE MATURING. In each of these groups there are table stock and technical varieties. It is difficult to establish such distinction in a few varieties (table stock and technical) since some possess good tasting qualities along with a high starch content, i.e. qualities which suit table requirements as well as technical production (var. Lorch). The selection of new varieties at collective and state farms is conducted on the basis of

1. a preliminary testing of a new variety at a specific farm and comparison with the best available varieties;

2. taking into consideration the methods for the utilization of potatoes accepted on the farm, i.e. where a potato industrial plant is located in the vicinity, technical varieties are assigned to the particular location, while where consumption is involved - table stock varieties will be selected. In either instance it is necessary to introduce all three groups of varieties (rapid, medium and late maturing).

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In addition, in order to prevent the contamination of varieties at the farms, it is necessary, wherever possible, to select varieties differing in color, i.e. one red tuber, another white tuber variety.

Government Regionalization divides all varieties into three groups: PRINCIPAL VARIETIES which have been sufficiently studied and are of greatest economic value under given conditions;

POTENTIAL VARIETIES which, on the basis of preliminary tests are of high quality but have not been adequately studied under conditions of production; depending upon their performance under practical conditions they are being transferred into either the principal group or are rejected;

TEMPORARILY ADMISSABLE VARIETIES which while distributed are less valuable for their economic qualities than are the principal varieties; the former will eventually be replaced by principal varieties or best potential varieties.

Among the regionalized varieties there is a group of canker-resistant varieties; these are the varieties: Jubel, Parnassia, Cobbler, Berlichingen, Majestic, Great Scott, Kalev, Aberdeen-Favorite, Courier, Phytophthora-Resistant, Paul Wagner, and Kungla.

In view of the particular danger of the potato canker disease, the canker-resistant varieties should receive the widest distribution, especially in the Western oblasts of the Union. The creation of an over-all protective belt of plantings of canker-resistant varieties in the Western oblasts of the Union represents one of the most important methods for the control of this disease.

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Characteristics of Regionalized Potato Varieties

ABERDEEN-FAVORITE. Produced by Sutton in Britain. Economic qualities: medium ripening table stock variety, of good taste; high yield; starch content medium; keeping quality good; resistant to canker. Plant erect; stem of medium pigmentation; foliage dies early. Leaf dark green, large, long, strongly serrated, lobes large with extended points; pronounced veining; petioles short. Blooming good but short; buds pigmented; calyx of flower green. Flowers white, not large; the locus of junction is raised and slightly plicate; anthers are yellow-green; regular; stigma not protruding. Tubers white, large, round, skin slightly peeling, eyes on surface; pulp white. Sprouts half-etiolated, red-violet; sprouts (exposed to light) have a ball-like oval base, pink, slightly pubescent; top lengthened, close, light-pink-green, slightly pubescent.

ALMA VARIETY. Produced in Germany by Zimbal in 1904 from the crossing of Early Surprise x Erst von Fromsdorf. Synonym Maincrop. Economic qualities; medium table stock variety of very good tasting quality; yield, starch content and keeping quality are average. Plant tall, leafage dies medium-late; stem green. Leaf dark green; lobes round, oval, with evenly bent margins, slightly serrated; veining medium. Bloom and fruit formation good. Peduncle and calyx green. Flowers white, large, with long sharp points; locus of junction of lobes of corolla regular; anthers regular, orange. Tubers dark, shallow-oval, smooth; eyes few on surface; pulp white; bud-eye cluster close. Sprouts - not etiolated, red-violet; sprouts (exposed to light - base elliptical-round, brown-pink green, scantily pubescent; top

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bluntly closed or half open, green; 3-4 root tubercles; covering leaf wide green.

BERLICHIEGEN VARIETY. Produced in Germany by the Pomeranian Seed Growing Industry in 1923 from the crossing of Pepo x Centifolia. Economic qualities: medium table stock variety, of good taste; yield high; starch content medium; keeping quality good; canker resistant and relatively resistant to scab. Plant tall, with multitude of leaves; stem angular; pigmentation regular or in spots; wings regular, green. Leaf not large; petiole, axils, stem, stalklets and veins pigmented; lobes round, distributed sparsely on long stalklets; end lobe round with heart-shaped base; slightly serrated. Bloom profuse; fruit formation observed; receptacle high; upper leaves observed; at locus of fusion of peduncle a clear ring of pigment, upper part of peduncle very short; calyx green, with pigmented base and awl-shaped sharp ends. Flowers very large, deep red-violet with white tips on the outside and white strips ("prosvet") on the inside. Occasionally double-petaled inside; the base of corolla petals tinted; anthers large, orange. Tubers red, of regular oval shape, peeling skin; eyes on surface, colored, darker than basic background; pulp white; bud-eye cluster close. Sprouts half-etiolated, red-violet. Sprouts (light) ball-like, red base; top half open, brown-red; root tubercles colored.

VERMONT VARIETY. Produced in America by Udhaus (?) in 1866, it is considered that the variety represents a sprout from the natural pollination of Jackson White with the pollen of Garnet Chile. Economic qualities:

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early table stock variety; yield, starch content and keeping quality ("lezhkost") medium; resembles Early Rose in its morphological traits. Plant not high; stem thick, straight, dark green; leafage dies early. Leaf dark green, medium or large bloom profuse; inflorescence close; calyx green, abundantly pubescent. Flowers large, white. Tubers dark pink, long, large; many eyes, distributed over entire tuber; skin smooth. ~~Seedlings~~ Sprouts - half-etiolated, red-violet; ~~seedlings~~ sprouts (light) ball-like deep red-violet base, strongly pubescent; top half opened, green, pubescent.

WOHLTMANN VARIETY. Produced in Germany in 1895; by Cymbal (?) from the crossing of Daber x Erst von Fromsdorf. Synonyms: Riabinka, Kustarka, Brunell, Lozovka, Professorka, Doctor, Wolfman, Koltman, Eltman, Alkhovka, Red Sabinovka, Ryzhaia, Latyshka, Sakharka. Economic qualities: large industrial variety; high yield and starch content; keeping quality ("lezhkost") good; in practice resistant to ring rot. Plant tall, strongly branched; foliage dies late; stem strongly pigmented, angular. Leaf directed at sharp angle; axils, veins, and stem of leaf pigmented; lobes narrow, long (length double that of width), bent along center vein; base of end lobe wedge-shaped; serrated, lightly veined. Bloom medium; no fruit formation observed; ~~florifersuseness~~ receptacle not pronounced, strongly pigmented. Flowers pale-red-violet, with white tips; anthers yellow, frequently irregular; ovary colored, pear-shaped. Tubers pink or red, oval-angular, skin lightly peeling; eyes on surface light, ~~past spread~~ bud-eye cluster close, stolons long. ~~Seedlings~~ Sprouts half-etiolated, red-violet; ~~seedlings~~ sprouts (light) ball-like, deep brown-red basis, not pubescent; top closed, small, pink, non-pubescent; root tubercles - 3; cover leaf pink.

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HERO VARIETY. Produced in Germany by Cymbal in 1895 from a crossing of Daver x Erst von Fromsdorf. Economic qualities: late table stock-keeping quality industrial variety; medium yield; high starch content; ("lezhkost")good. Plant tall, strongly branched, well leafed; foliage dies late; stem strongly pigmented. Leaf dark green, large; petioles and veins pigmented; frequently found "ivy-leaved", lobes large, wide, with regular margins; medium veining. Bloom good; fruit formation not observed. Flowers red-violet with white tips at both in-and outside. Anthers orange, regular; ovary lightly colored. Tubers red, round, peeling; eyes on surface lighter than basic background; pulp white, bud-eye cluster close. Sprouts/vast-gregarious. Seedlings - half-etiolated, red-violet; sprouts seedlings-(light) ball-like, dark brown-red, non-pubescent base; top closed, small, pink, non-pubsecent; root tubercles - 3; cover leaf pink.

GOLLANDSKI (HOLLAND) VARIETY. Produced in Holland by Van Hutsen from the crossing of Prima x Franche. Synonyms: Model, Paul Kruger. Economic qualities: very late variety; yield and starch content medium; keeping quality ("lezhkost") good; resistant to diseases and degeneration. Plant tall, strongly branched, well leafed; foliage dies late; stem is well pigmented. Leaf dark green, very large; lobes large, oval with regular margins; lobes small, serration light; veining sharp. Bloom profuse; fruit observed very seldom; inflorescence spread; receptacle highly pigmented, upper leaves noticeable; veining sharp; calyx of bud strongly pigmented; Flowers very large, pale red-violet; with white ends from in-and outside; line (locus) of fusion of lobes of corolla regular; anthers regular,

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orange, large. Tubers white, rounded, with thinly peeling skin; eyes on bud-eye cluster close surface; pulp white; nest-gregarious; stolons long. Sprouts partly-etiolated, red-violet; sprouts (light) ball-like, pink, pubescent base; top blunt, closed, pink-green; from 2 to 3 root tubercles; covering leaf small, wide, green.

GRACIA VARIETY. Produced in Poland by Dalkovsky in 1895 from the crossing of Andersen x Reichskanzler. Economic qualities: late industrial variety; yield and starch content medium; strongly susceptible to mosaic diseases. Plant wide, low; branching and foliage good; foliage dies late; stem darkly pigmented; wings light, slightly plicate. Leaf not large; medium veining; margins of lobes plicate; slightly serrated; stems pigmented; on the first pair of lobes frequently a split; last lobe reverse-ovoid. Bloom medium, inflorescence loose; produces fruit occasionally. Flowers: not large, red-violet, with small white ends on the exterior, rapidly burning out (?); the young flowers have red veinlets around the corolla star. Tubers dark red, round, peeling; eyes light, flat; pulp white; bud-eye cluster close; stolons long; tubers difficult to detach. Sprouts partly-etiolated, red-violet; sprout (light) ball-like, deep red non-pubescent base; upper part green, scantily pubescent; top closed or partly open; root tubercles 3-4, not colored.

GREAT SCOT VARIETY. Produced in England by Bayer in 1906 from the crossing of Imperator x Champion. Economic qualities: stable stock, medium maturing; medium yield; starch content low; taste good; keeping quality ("lezhkost") good; resistant to canker. Plant tall, sparsely

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leafed; foliage dies medium to late; stem straight, spotted pigmentation. Leaf dark green, shiny; end lobe round; first and secondary lobes angular; strongly serrated; medium veining. Bloom weak; buds fall off easily; receptacle green, short; peduncle pigmented; calyx strongly pigmented. Flowers white, medium; anthers yellow-green; pistil bent, not prominent. Tubers white, round; top and stolon in a depression ("vpadina"); skin smooth and large-netted; eyes flat, concentrated at top; pulp white. Sprouts partly etiolated, red-violet; sprout (light) ball-like, brown-red, pubescent base, pubescence close; top open, green-pink, light pubescence; root tubercles - 4; covering leaf wide, green.

DEODARA VARIETY. Produced in Germany by Kamek in 1913 from the crossing of Jubel x Deutsches Reich. Economic qualities: medium maturing table stock variety; yield and starch content medium; keeping quality ("lezhkost") good; strongly susceptible to ring rot. Plant tall; good foliage which dies late; stem erect, irregularly pigmented; wings lightly plicate. Leaf dull, dark green, large margins regular; stem lightly pigmented; veining sharp; lobes oval, large; medium serrated. Bloom profuse; inflorescence loose; bears fruit; receptacle lightly pigmented; upper leaves frequent; lower part of peduncle short, pigmented; upper part of peduncle and calyx green; center veins pigmented. Flowers red-violet; with white tips on the inside and white stripes on the exterior; anthers orange; tubers white, large, ovate; umbel (depressed); eyes shallow; pulp white; bud-eye cluster close. Sprouts partly etiolated, red-violet; sprouts (light) oval, red-violet, lightly pubescent base; top closed or partly open; brown-red; 3-4 root tubercles.

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YELLOW ROSE VARIETY. Domestic. Synonyms: Blue Flower, Paralitik, Belozerka, Korenastaia, Sparzhevka. Economic qualities: yield and starch content medium. Plant not tall, well leafed; leaves die late; stem straight; pigmented; top of stem has dark margin; wings plicate. Leaf not large; lobes oval (obovate); margins plicate, veining light; stem of leaf, petioles and veins pigmented; slightly serrated. Bloom good; inflorescence spread; receptacle and lower part of peduncle pigmented; base of calyx green. Flower not large, red-violet, with white stripes on the exterior and white spots on the inside; ends of lobes of corolla very short; anthers orange, frequently misshapen; ovary brightly colored. Tubers irregularly colored, pink at top, at umbel (?) (" pupovina")yellow; of linear, irregular shape; eyes medium depth, pulp white. Sprouts partly etiolated, red-violet; sprouts (light) ball-like, red, lightly pubescent base; top pink-green, closed or partly open; 3-4 tubercles.

IMANDRA VARIETY. Produced in the USSR in the Polar Department of the All-Union Institute of Plant Industry by I. O. and M. N. Vesselovsky in 1934 from the crossings of Jubel and Solanum andigenum (Tocanum). Economic qualities: medium ripening, table variety of high yield; medium starch content; relatively resistant to phytophthora; resistant to canker. Plant not tall, medium spread, strongly leafed; stem thick, pigmention interspersed. Leaf large, medium serrated, with large lobes, shiny; petiole and stem pigmented. Bloom profuse; inflorescence very large, tight (close); receptacle, peduncle and calyx strongly pigmented; anthers yellow, regular. Flowers very large, deep red-violet, completely colored

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on the inside, white tips on the outside. Tubers white, flat; eyes flat, pink, skin smooth; pulp white-yellow; bud-eye cluster close; sprouts partly etiolated, red-violet.

KALEV VARIETY. Produced in Esthonia by Amisep in 1933 from the crossing of Pepo x Edzell Blue. Economic qualities; medium ripening table stock variety, of good taste; high yield; medium starch content; keeping quality ("lezhkost") good; canker resistant; most suspeptible to wrinkled mosaic and ring rot. Plant wide, well leafed; foliage dies medium-early; stem lightly pigmented. Leaf has round lobes infrequently placed with small "bitting" ends; base of end lobe heart-shaped; petiole long; slight serration; veining large, sharp; Bloom profuse; no fruit formation; receptacle high; sharp tips of calyx short; buds green. Flowers not large, red-violet, with short white ends on in-and outside; anthers orange; stem erect; ovary round. Tubers white, round, parsnip-shaped; skin peeling; few eyes of medium depth distributed at top; pulp white, bud-eye cluster close. Sprouts partly etiolated, red-violet; sprouts (light) ball-like, brown-red, lightly pubescent base; top long, partly opened, brown-green; wide covering leaf.

COBBLER VARIETY. Introduced from America; possibly a sprout of the Early Rose; Economic qualities: early, table stock variety; yield and starch content medium; keeping quality ("lezhkost") poor; canker resistant; non-resistant to ring rot. Plant wide, strongly leafed; leaves die early; stem strongly pigmented. Leaf large, abundantly pubescent; base of end lobe heart-shaped; lobes wide; small lobes large, linear, angular; strongly

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serrated; veining non-sharp. Bloom profuse; inflorescence tight; fruit formation infrequent; lower part of peduncle is one and a half times longer than the upper part; crown of calyx pigmented; buds pigmented. Flowers red-violet with white tips, large, burning quickly; anthers large, orange. Tubers white, round, skin does not peel lightly; eyes shallow, pulp white; bud-eye cluster close; sprouts partly etiolated, red-violet; sprouts (light) ball-like-oval, pink base, strongly pubescent; top tightly closed or partly opened, pink-green; brown tubercles - 4-5; covering leaf elongated, green.

KOHBNEVSKY VARIETY. Produced in the USSR at the Korenev Selection Station in 1922 from the crossing of Swetez (?) x Symslovski (Fürstankrone). Economic qualities; medium-late industrial variety; yield and starch content high; keeping quality good. Plant tall, strongly branched, well leafed; leaves die late; stem angular, green; Leaf large, dark green, abundantly pubescent; lobes large, obovate-oval, with regular margins. Lobes centered, directed downward; light serration; sharp veining. Bloom good; inflorescence spread; fruit formation not observed; receptacle high; lower part of peduncle green, upper part pigmented (in contrast to Lorch); majority of buds have star on tips. Flowers bright red-violet, with clearly noticeable white spots on in-side and white tips on outside; anthers orange. Tubers white, round-ovate; skin does not peel lightly; eyes of medium depth; pulp white, when sliced brown; bud-eye cluster close; stolons fibrous. Sprouts partly etiolated, red-violet; sprouts (light) ball-like, bright

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red base. Medium pubescence, straight hair; top closed, pink-green, non-pubescent; root tubercles four or five; covering leaf pinkish.

CORNWALLIS VARIETY. Produced by Lambert; origin unknown. Economic qualities; table stock medium maturing variety, yield and starch content medium. Plant tall, well leafed; stem pigmented. Leaf dark green, very large; lobes large; strongly serrated; light veining. Bloom good; inflorescence loose; buds pigmented. Flowers large, red-violet, with white tips on the inside and white stripes on the outside; locus of fusion of lobes of corolla plicate. Anthers regular, yellow; pistil straight; stigma large, protruding, double and triple-lobed; tubers white, of regular oval shape; skin peels finely, eyes on surface; pulp white; bud-eye cluster close. Sprouts partly etiolated, red-violet; sprouts (light) oval, brown-red base, medium pubescence; top open, pink-green; root tubercles 4 and 5; covering leaf elongated.

KRASNOGLAZKA (RED EYE) VARIETY. Produced in France in 1884 by the Agricultural Institute Beauvais (Bovee) and named Institute Beauvais (Bovee); synonyms: Tula, Pluishka, Livenski, Broken, Model, Beloslonka, Snezhinka, Beluga, French, Austrian. Economic qualities: medium maturing table variety; medium yield; low starch content; keeping quality fair; susceptible to leaf curl. Plant tall; foliage leafage dying medium-late; stem slightly angular, lightly pigmented; starchiness plicate, ("Krak limalistost"). Leaf shiny, green, thin; end lobe drooping, veining light; lightly serrated; lobes linear-oval. Veins and seam of lobes pigmented; small lobes elongated, centered; Bloom good; inflorescence spread; non-fruit bearing; receptacle protruding;

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peduncle and calyx green; lower part of peduncle two and a half times as long as upper part; at (locus) point of fusion a ring of pigment; green buds; Flowers white, large; tips abundantly pubescent; anthers orange; Tubers white with rose eyes, large, rounded-oval; eyes on surface; skin smooth; pulp white; bud-eye cluster close non-leveled. Sprouts partly etiolated, red-violet; sprouts (light) ball-like-oval, rose base; top partly opened or closed, green; medium pubescence; root tubercles 3-4; lightly colored.

KRUGER VARIETY. Produced in Germany by Cymbal in 1904 from the crossing of Daber x Erst von Fromsdorf. Economic qualities: late forage variety; high yield; starch content and keeping quality medium; strongly susceptible to spotting/("krapchatost") (speckling, mottling). Plant tall, poorly leafed; foliage dies late; stem erect, spotted brown pigmentation; stipules leaf-like. Leaf yellow-green, long petioled; lobes sit on long stems; end lobe rounded, with stretched tip and wedge-shaped base. Bloom good; inflorescence loose; fruit formation not observed; inflorescence high; appears from under plant; lower part of peduncle twice as long as upper part; some buds have stars at their tips. Flowers pale red-violet with white tips on inner side and white stripes on the exterior; young flowers have red veining around stars of corolla; anthers orange, occasionally misshapen; stigma ball-like; ovary pear-shaped. Tubers white, round or elongated; skin lightly peeling; deep eyes; white pulp; bud-eye cluster close; stolons long; tubers detach with difficulty. Sprouts partly etiolated, red-violet; sprouts (light) have ball-like or ball-oval base, dark pink, scantily pubescent or non-

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pubescent; top closed, rose-green; root tuberoles four; covering leaf pinkish.

KUNGLA VARIETY. Produced in Esthonia by Amisep from the crossing of Pepo x Centifolia. Economic qualities: medium-late table stock variety; yield and starch content medium; canker resistant. Plant tall; stem bent (knee-bent). Leaf light green; lobes dull, not large, rounded, with sharp veining; light serration. Bloom good; inflorescence spreading; receptacle green, strong; peduncle green, long. Flowers red-violet with white tips; (locus) line of fusion (junction) of lobes of young flowers slightly plicate; anthers light orange, conus regular; stigma small, dark green; Tubers white, rounded; eyes on surface; skin does not peel lightly; pulp white; Sprouts partly etiolated, red-violet.

COURIER VARIETY. Produced in America, origin unknown. Synonyms: Hammer and Sickle; Snezhinka No. 2 and Snezhinka No. 3. Economic qualities: medium-late table stock variety of good taste; medium yield; starch content high; suitable for early technical use; keeping quality good; canker resistant, but very susceptible to phytophthora (leaves and tubers). Plant not tall, well leafed; foliage dies early; stem green; leaf shiny, drooping; first pair of lobes presses upon end lobe; at point of fusion (junction) of lobes stem pigmented; serrated and lightly veined. Bloom light; no fruit; inflorescence green, not large; peduncle, calyx and buds green, dropping. Flowers not large, white, with strongly pubescent, sharply pointed ends tips on the exterior; anthers light yellow or green, undeveloped; stigma small and

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smooth; Tubers white, flat, rounded, skin smooth; eyes on surface; pulp white; bud-eye cluster close. Sprouts partly etiolated, red-violet; sprouts (light) ball-like, light pink-green base; pubescence strong, straight; top closed, light green, non-pubescent or lightly pubescent; 4 root tubercles.

LOKKH VARIETY. Produced in the USSR by the Korenev Selection Station in 1922 from the crossing of Swite, (Sweetest?) x Symslovski (Fürstenkrone). Economic qualities: medium-late table stock/industrial variety; good taste; high yield; high starch content; keeping qualities ("lezhkost") good; practical resistance to ring rot; Plant tall, strongly branched, well leafed; leaves die medium-late; stem angular, lightly pigmented or green. Leaf light green; frequently found to be ivy-leafed; lobes not large; first pair of lobes and small lobes bending downward; small lobes centered serration and veining light. Bloom profuse; inflorescence loose; fruit-bearing infrequent; receptacle and peduncles green, (constrasted with the Korenev variety); calyx green; sharp points frequently grow to leaf size and shape. Flowers pale, red-violet with white tips; anthers orange. Tubers white, round-oval; also elongated; skin peeling at top; eyes on surface, placed all over tuber; pulp white, in slicing has green-yellow tint. Sprouts partly etiolated, red-violet; sprouts (light) oval, brown-red, strongly pubescent base; top closed or half opened with narrow elongated leaves, rose-green, lightly pubescent; root tubercles 4; covering leaf green, narrow.

MAJESTIC VARIETY. Produced in England by Findlay in 1911 from the crossing of Wild Potato x British Coin. Economic qualities: Medium ripe

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table stock variety, of good taste; yield and starch content medium; keeping quality good; canker resistant. Plant tall, medium foliage; leaves die medium-late; stem pigmented. Leaf dark green; first pair of lobes press upon end lobe; lobes are elongated, with regular margins; ends of lobes stretched; ivy-leafage occurs; strongly serrated. Bloom profuse; some fruit formation; inflorescence spread; receptacle dark green; buds pigmented with violet veining. Flowers large, white, frequently violet-veined on the outside; anthers orange; stalk thin, long. Tubers white, of oval regular shape, smooth or lightly netted skin; eyes on surface; pulp white-yellow; bud-eye cluster close. Sprouts partly etiolated, red-violet; sprouts (light) oval, light rose-green base, strongly pubescent; close hair; top blunt, closed, green, medium pubescence; root tubercles - 5.

MERKER VARIETY. Produced in Germany by Richter in 1892 from the crossing of Imperator x Trofin (?). Synonyms: Globus, Pluishka; Mestny (local); Russian, Esthonian, Uvelts; Babinka, Vinka, Stekhovski Urozhainii; Economic qualities: medium-late table stock-industrial variety; medium yield; high starch content; keeping quality poor. Plant tall, strongly branched, well leafed; foliage dies medium-late; stem with sharp pigmentation centered primarily at axil. Leaf grey-green, strongly pubescent; lobes not large, with plicate margins; small lobes round (contrasted with NARODNY VAR.); sharply serrated and veined. Bloom profuse; no fruit; inflorescence spread; occasionally upper leaves seen; receptacle high; peduncle pigmented; buds strongly pigmented. Flowers blue-violet with

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white tips; anthers orange, frequently misshapen; (contrasted with NARODNY); pistil short, deformed; stigma large, dark green. Tubers white, with blue tint at tops and top eyes, rounded; skin smooth or peeling lightly; eyes on surface; pulp white, gets grey in slicing; bud-eye cluster close; Sprouts partly etiolated, blue-violet; sprouts (light) ball-like, dark brown-blue base; pubescence medium or strong; top closed, blue, slightly pubescent.

PARNASSIA VARIETY. Produced in Germany by Kameke in 1913 from the crossing of Jubel x Deutsches Reich. Economic qualities: medium-late table stock-industrial variety; medium yield; high starch content; keeping quality good; canker resistant; strongly affected by the disease which causes the blackening of stems. Plant tall, well leafed; dying of leaves medium-late; stem pigmented. Leaf dark green, shiny bent downward along center vein; lobes small with sharp veining and plicate margins; base of end lobe heart-shaped; strongly serrated. Bloom profuse; fruit formation good; inflorescence loose; receptacle and peduncle lightly pigmented; calyx pigmented. Flowers red-violet, evenly colored; double petals 90-100] external; anthers orange; pistil protruding. Tubers white, elongated-oval; skin smooth; eyes numerous; on surface; pulp white; bud-eye cluster close. Sprouts partly etiolated, red-violet; seedlings sprouts (light) base ball-like, oval, dark brown-red; lightly pubescent, straight hair; top dark brown-red, partly opened, very lightly pubescent.

PAUL WAGNER. Produced in Germany by the Pomeranian Institute of Seed Growing in 1928 from the crossing of Industry x Jubel. Economic

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qualities: medium-late table stock variety; medium yield; good starch content; keeping quality medium; canker resistant. Plant tall; stem angular, strongly leafed, sharply pigmented in the axils of leaves; Leaf under right angle, not large, short, dark green, thick, strongly pubescent. Ivy leaf resembance frequent; margins of lobes plicate; end lobe reverse ovoid; center lobes inclined downward. Bloom good; buds green. Flowers white, with short "sitting" sharp-ended lobes, with open cuts and double petals at exterior; anthers orange, regular; stigma strongly protruding. Tubers white, flat-oval, smooth; eyes on surface, pulp white. Sprouts partly etiolated, blue violet.

EARLY ROSE. Produced in America by Bresee in 1867 from the self-pollination of the Garnet Chile. Synonyms: Rozovka, Amerikanka, Skorospelka, Early Rose, Mestny Stolovy, Skorobezhka, Turka, Yanovka, Olkhovka, Karynovka, Ruzhovaia, Latyshka, Dovzhyk, Mosiachnaia, Pisarevka, Ukusny. Economic qualities: early table stock variety, very tasty; yield and starch content medium; keeping quality poor; very strong susceptibility to wrinkle mosaic and phytophthora. Inclined to be affected by leaf roll. Plant wide, not tall; medium branching; good foliage which dies early; stem slightly angular, rather strongly pigmented. Leaf dark green, shiny, drooping; first pair of lobes presses upon end lobe; axils and veins of leaf pigmented; veining and serration slight; lobes elongated, first and secondary centered in the majority of cases. Bloom good; fruit formation observed on separate clones; lower part of peduncle pigmented, two to three times longer than upper part; sharp tips grow in leaf fashion; buds strongly pubescent.

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Flowers white, anthers orange, regular, ovary colored in cut. Tubers pink, elongated oval; skin smooth; eyes few, on surface, distributed along entire tuber, of same coloring as skin; pulp white, bud-eye cluster close; stolons short; Sprouts partly etiolated, red-violet; sprouts (light) base oval, pink, strongly pubescent; tip partly open, pink-green; lightly pubescent; 4-5 brown tubercles; covering leaf green, stretched (elongated).

ROSE FROM MILET (?) Local variety. Synonyms: Daughter of Early Rose, Milet, Miletski, Turchanka, Late Rose. Economic qualities: medium ripening table stock-industrial variety; high yield; low starch content; keeping quality medium; strongly affected by degeneration. Plant tall, poorly branched, well leafed; leaves die medium-late; stem erect, strongly and regularly pigmented. Leaf dark green, shiny; petioles, axils and veins of leaf pigmented; lobes oval, rolled in screw fashion; first part of lobes covers (closes) end lobe; small first and secondary lobes angular in the majority of cases. Bloom good; fruit formation observed seldom; inflorescence loose; receptacle high; pigmented; sharp tips of calyx long, frequently grow to leaf size. Flowers white; anthers orange; ovary colored. Tubers large, dark pink, long, smooth; many eyes on surface, distributed along entire tuber; pulp white; has occasionally violet veining; bud-eye cluster close. Sprouts partly etiolated, red-violet; sprout (light) base oval, dark brown-red; pubescence medium; hair close; tip closed or partly open, rose-green; medium pubescence; tubercles - 4.

SWEETEST (?) (SWETEZ) VARIETY. Produced in Poland by Dalkovsky in

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1902 from the crossing of Hotman x Gracia. Economic qualities: late industrial variety; medium yield; high starch content; keeping quality good. Plant tall, strongly branched; foliage dies late; stem green; Leaf not large, light green; base of end lobe wedge-shaped; margins of lobes redden in the fall; all lobes centered; light serration; sharp veining; profuse bloom; fruit formation good; inflorescence spread; receptacle long, green; peduncle and calyx green; sharp tips of calyx sharp awl-shaped (subulate). Flowers deep-red violet, with white margins on the inside and white tips on the outside. Around star or corolla stronger pigmentation; anthers orange. Tubers white, round; skin strongly peeling; eyes of medium depth; pulp white, reddens in slicing; bud-eye cluster close; stolons long; tubers detach with difficulty. Sprouts partly etiolated, red-violet; sprout (light) base ball-like, brown-rose, medium pubescent, straight hairs; top rose-green, closed or partly open.

SILESIA VARIETY. Produced in Germany by Cymbal in 1895 from the crossing of Daber x Samson. Synonyms: Saxony, Puntovka, Luiba, Pirozhok, Zelenaia, Nerosim, Obyknovenny, Alcohol, Latyshka, Zheltaia, Sotka, Sakharnaia, Kustovka, Kustarka, Sibirskaia, Speshka, Belaia, Sychiki, Pol'kovka. Economic qualities: late table stock industrial variety; medium yield; high starch content; medium keeping quality. Plant tall, strongly branched; foliage dies late; stem has lightly spotted pigmentation; on top of stem are wings, strongly pigmented. Leaf blue-green, under sharp angle; lobes narrow oval; first pair of lobes points downward; ivy-shaped leaves frequent; light serration; sharp veining; good bloom; no fruit

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observed; inflorescence ~~friable~~ loose; receptacle and calyx green; base and veins of calyx pigmented. Flowers red-violet, with white tips; anthers light orange, regular; pistil lightly protruding. Tubers white; top frequently elongated; skin peeling; eyes distributed along the entire tuber, of medium depth; pulp white-yellow; pink in slicing; bud-eye cluster close; stolons long; tubers detach with difficulty. Sprouts partly etiolated, red-violet; sprout (light) base ball-like, deep red, non-pubescent; top rose, very short, closed.

SMYSLOVSKY VARIETY. Produced in Germany by Richter in 1905, under the name of Fürstenkrone from the crossing of Koenigin Karola x Cyclon; the Russian agronomist Smyslovsky improved the variety by selection. Synonyms: Grachik, Always Better. Economic qualities: medium maturing table stock variety; yield medium, high starch content; keeping quality good; relatively resistant to drought. Plant wide spread, strongly leafed and branched; foliage dies medium-late; stem knee-like with light pigmentation. Leaf light green, large; lobes oval, point downward; between end lobe and side lobes membrane (film); light serration; medium veining. Bloom and fruit formation profuse; inflorescence spread; receptacle very high, extends above plant; upper leaves observed; lower part of peduncle is twice as long as upper; upper part of peduncle and calyx green; buds lightly pigmented; Flowers large, white; line of ~~fusion~~ junction of lobes of corolla plicate; anthers regular, bright orange; two or three light spots on stigma. Tubers white, long; skin smooth; eyes numerous, of medium depth, distributed over entire tuber; pulp white; bud-eye cluster close. Sprouts partly etiolated, red-violet; sprouts (light) base ball-like or oval; brown-red, lightly pubescent; covering leaf green, wide.

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SOVIETSKY VARIETY. Produced in the USSR by the former Forenev Selection Station in 1922 from the crossing of Narodny x Smyslovsky. Economic qualities: medium-early, table stock-industrial variety; of good yield, with high starch content and an early accumulation of it; keeping quality medium; non-resistant to disease. Plant wide; foliage dies medium early; stem green. Leaf light green, large, thick, strongly pubescent; lobes wide; leaf bent down along center vein; end lobe elongated with stretched point-and-heart-shaped base; lobes elongated, at end series there is frequently one pair of lobes; medium serration; no downward lobes and ivy-like foliage observed (in contrast to Lorkh); Bloom good; no fruit formation; buds and peduncle green; abundantly pubescent; sharp tips of calyx grow to size of leaves. Flowers pale red-violet; white tips on in-and outside; anthers yellow; stigma large; ovary stretched. Tubers white, elongated; skin peeling at top; eyes not deep, distributed along entire tuber; pulp white; bud-eye cluster close. Sprouts partly-etiolated, red-violet; sprout (light) base ball-like-oval, red-green, lightly pubescent; tip closed, rose, lightly pubescent; covering leaf green, stretched.

CENTIFOLIA VARIETY. Produced in Germany by Kameke in 1919 from the crossing of Broken x Flora. Economic qualities: table medium-late maturing variety; yield and starch content medium; keeping quality good. Plant wide, well leafed; stem almost green. Leaf not large; lobes round with short tips; base heart-shaped; veins and seams of lobes lightly pigmented; lightly serrated. Bloom profuse; produces fruit; buds green. Flowers red-violet with white tips; few double petals; pigmented ring at junction of peduncle;

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upper part of pedunole and calyx green (as compared to similar variety BERLICHINGEN); stigma green, smooth. Tubers round, red; eyes not deep, dark colored; skin red, net-like; pulp white; bud-eye cluster close. Sprouts partly etiolated, red-violet; sprout (light): base ball-like, red-violet, non-pubescent; tip closed or partly opened; tubercles colored.

CHUGUNKA (mutant of KRASNOGLAZKA) VARIETY. Economic qualities; medium ripe, table stock-forage variety; medium yield; low starch content; poor keeping quality. Plant tall, lightly leafed; stem green; wings weak. Leaf light green, thin, with slight veining and serration; lobes elongated-oval; end lobe drooping; axils and seams of lobes pigmented. Bloom good; inflorescence spread; peduncle green, with dark ring of pigment at junction; green calyx. Flowers blue, large; ovary non-colored. Tubers blue with white spots, large, round-oval; eyes colored, pulp white; bud-eye cluster close. Sprouts partly etiolated, blue-violet; sprout (light) base ball-oval like, blue-violet, strongly pubescent; tip blue-green, medium pubescent; brown tubercles, 3-4;

PHYTOPHTHORA-RESISTANT VARIETY. Produced in the U.S.S.R. by the Institute of Potato Industry in 1931 from the crossing of Solanum demissum x Granat x Granat x Narodny. Economic qualities: medium-late, table stock-industrial variety; yield, starch content and keeping quality medium; resistant to phytophthora under field conditions; resistant to canker. Plant tall, branched; foliage dies medium-late; stem green with sharp pigmentation in leaf axil. Leaves dark green; petiole, stem, and seams of lobes sharply pigmented; end lobe reverse ovoid; serration and veining medium. Bloom good; inflorescence loose; pigmented ring at junction of

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peduncle; calyx very small, as compared to corolla. Flowers blue-violet; with white, very short tips; lobes of corolla pigmented at base; anthers small, irregular, yellow-green; pistil bent; stigma double-lobed; ovary pigmented at base and in cut. Tubers elongated-oval, blue-violet, irregularly colored; color changes sometimes and produces red-violet tint; skin colored, net-like, peeling; eyes on surface, colored darker than base, distributed over entire tuber; pulp does not darken when sliced. Sprouts partly etiolated, blue violet; sprout (light) base ball-oval like, dark blue; medium or weak pubescence; tip blue-green, partly open; colored tubercles; covering leaf blue.

ELLA VARIETY. Produced in Germany by Cymbal in 1898 from the crossing of Early Rose x Erst von Fromsdorf. Economic qualities; medium-early table variety; high yield; medium starch content; keeping quality good. Plant wide, stem light green, wide oval with short end; sharp veining; light serration. Bloom profuse; inflorescence spread; produces fruit; green buds. Flowers white, large; line of fusion plicate; anthers large, orange. Tubers white, flat-oval; eyes on surface; skin smooth; pulp white; bud-eye cluster close. Sprouts partly etiolated, red-violet; sprout (light) base ball-like, light rose, pubescent; tip tlong, open, green;

EPICURE VARIETY. Produced in England by Sutton in 1897 from the crossing of Magnum Bonum x Early Regent. Synonym: Epicurean ("Epicureets"). Economic qualities; early table stock variety; yield and starch content medium; keeping quality good; strongly affected by wrinkled mosaic and ring-rot; non-resistant to phytophthora. Plant tall, lightly leafed; foliage

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dies early; stem erect, thick, strongly pigmented; wings regular. Leaf not large, dark green, shiny; end lobe smaller than side lobes; lobes elongated-oval; first lobes angular, secondary placed on stems and directed to base of leaf; strohgly serrated; light veining. Bloom profuse; inflorescence gregarious; no fruit formation; receptacle high, extends above plant, pigmented; calyx green, with dark corolla; pigmented buds; Flowers white; inner double petioles found frequently; anthers light yellow. Tubers white, getting pink towards spring, large, barrel-shaped; smooth skin; eyes deep, distributed along entire tuber; pulp white; bud-eye cluster close. Sprouts partly etiolated, red-violet; sprouts (light) base oval, deep red-violet; strongly pubescent; straight hairs; tip bluntly closed, rose-green, slightly pubescent; covering leaf rose.

EPRON VARIETY. Produced in the USSR at the Leningrad zonal station in 1929 from the crossing of Epicure x Alma. Economic qualities: rapid ripening table stock variety of good yield; low starch content; keeping quality good. Plant tall, erect; stem pigmented. Leaf dark green, shiny, petiole long, pigmented at base; lobes on stems; margins of lobes plicate; tips elongated; strongly serrated; medium veining. Bloom good; fruit bearing; receptacle straight; lower part of peduncle and buds pigmented; sharp tips short; corolla of calyx pigmented. Flowers white; tips short; anthers orange; pistil protruding; stigma long; stem erect; ovary extended; much pollen. Tubers white, round-flat; skin peeling; few eyes on surface; pulp white; budp eye cluster close. Sprouts partly etiolated, red-violet; sprout (light) base ball-like, brown-red; pubescence close; tip open, rose-green.

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JUBEL VARIETY. Produced in Germany by Richter in 1908 from the crossing of Victoria Augusta x Seianets 78/92; synonyms: Jubilar, Yasenelistny, Kolbinsky. Economic qualities: medium-early table stock variety; yield and starch content medium; keeping quality good; canker resistant and relatively resistant to scab. Plant tall, lightly leafed; foliage dies medium-late; stem lightly pigmented; stipules leaf-like. Leaf not large, bent downward, with long petiole; lobes small, with plicate margins, bent downward; sharp veining; profuse bloom, good fruit formation. Flowers large, red-violet, with white tips; frequently inner double petals; anthers orange. Tubers large, white, long; skin net-like, eyes not deep; pulp white, darkening in slicing; bud-eye cluster close. Sprouts partly etiolated, red-violet; sprouts (light) oval base, dark-brown-red; hairs erect; tip dark brown-red, long, partly open, scantly pubescent.

SEIANETS VARIETY 001969 s/28 (year) Produced in the USSR at the Institute of Potato Industry and the Novozybkovsky Selection Station in 1928 from the crossing of the varieties Krüger x Smyslovsky. Economic qualities: medium-early maturing table stock variety, of good taste, high yield; medium starch content; good keeping quality; not much affected by disease. Plant wide, strongly leafed; stem green, knee-life. Leaf very long, under right angle; veining and pubescence light; base of end lobe wedge-shaped; first pair of lobes slightly directed downward; two pairs of small lobes. Bloom good; inflorescence loose; lower part of peduncle pigmented; green buds; Flowers red-violet, with white tips on the inside and white stripes on the exterior. Tubers white, long, with numerous eyes,

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not deep; smooth skin; white pulp. Sprouts partly etiolated, red-violet; sprouts (light) base ball-oval like, lightly pubescent, brown-rose-green; tip partly open, green-rose; covering leaf elongated.

SEIANETS 144 - OKTIABRENOK. Produced in the USSR at the Petrovsky Selection Station in 1928 from the crossing of Smyslovsky X Aza. Economic qualities: early table stock-industrial variety; medium taste; high yield and starch content; good keeping quality. Plant not tall; spread; green stem. Leaf dark green, with light veining. Bloom profuse; fruit bearing. Flowers pale red-violet. Tubers white, round, do not peel lightly; bud-eye cluster close. Sprouts partly etiolated, red-violet.

- SEAINETS No 1 - YUBILEINY. Produced in the USSR at the Petrovsky Selection Station in 1928 from seeds obtained from the natural fruit of Epicure; Synonym: Epicure No 1. Economic qualities: early table stock variety of good taste; good yield; medium starch content; keeping quality good. Plant well leafed, of medium height; stem slightly pigmented. Leaf dull, strongly serrated, with slightly plicate margins, right angle. Bloom good; flowers pale red-violet. Tubers white of type of "Epicure" but larger and eyes less deep; bud-eye cluster close. Sprouts partly etiolated, red-violet.

SEIANETS 3593. PRODUCED in the USSR at the Kiev Experiment Station in 1929 from the crossing of Krüger x Smyslovsky. Economic qualities: medium-early maturing universal variety; high yield; medium starch content; keeping quality good. Plant low, lightly spread; stem slightly pigmented, thin, knee-like. Leaf large, shiny, dark green; medium serrated. Inflorescence

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gregarious; bloom profuse; receptacle high, pigmented. Flowers white, large. Tubers white, round and elongated; skin smooth; bud-eye cluster close. Sprouts partly etiolated, red-violet.

SEIANETS 7/22. Produced in the USSR at the Voronezh zonal Station of the Institute from the crossing of Krüger x Smyslovsky; Economic qualities: medium early table stock variety, of good tasting quality; yield and starch content good; keeping quality good. Plant tall, powerful, loose; stem knee-like, sharply pigmented in spots. Leaf large, medium serration and veining; margins of lobes regular; end lobe round, large. Bloom good; inflorescence gregarious; no fruits. Flowers red-violet, large with white stripes on in- and outside. Tubers white, round-oval; deep eyes; smooth skin; white pulp; bud-eye cluster close. Sprouts partly etiolated, red-violet.

SEIANETS 6780. Produced in the USSR at the Belorussian Selection Grain Station in 1932 from the crossing of Model x Alma. Economic qualities: early-medium maturing table-stock-forage variety; good yield; medium starch content; keeping quality medium. Plant tall, dark green, well leafed. Leaf large, wide; downward lobes onto stem observed. Inflorescence limited; bloom light; some fruit. Flower white, not large. Tubers red, flat-round. Sprouts partly etiolated, red-violet.

SEIANETS 56. Produced in the USSR at the Polessky Agricultural Experiment Station in 1929 from an unknown crossing. Synonyms Narymchanin. Economic qualities: Medium maturning table stock-forage variety; high yield; medium starch content; keeping quality good. Plant well leafed; stem almost straight, lightly pigmented in the leaf axils; Leaf very large, bright green, dull; medium serration; lobes large, small lobes round; stem pigmented. Bloom

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profuse; fruit bearing; receptacle high, thick, pigmented. Flowers white. Tubers large, white, with pink tint, rounded; eyes of medium depth; white pulp; bud-eye cluster close. Sprouts partly etiolated, red-violet.

SEIANETS 74. Produced in the USSR at the Leningrad Zonal Station of the Institute of Potato Industry in 1932 from the crossing of Epicure x Centifolia. Economic qualities: medium-early maturing table stock variety, good tasting quality, high yield; good starch content. Bloom profuse, flowers white; tubers white, oval; eyes small, skin peeling. Sprouts partly etiolated, red-violet.

SEIANETS 242-261. Produced in the USSR at the Ulianovsk Zonal Station of the Institute of Potato Industry in 1931 from the crossing of Deodara x Smyslovsky. Economic qualities: early table stock variety; high yield; high starch content; fairly resistant to drought. Plant tall, half-loose (?); stem lightly pigmented. Leaf lightly pubescent, medium serrated; petiole and stems pigmented. Inflorescence gregarious; receptacle green; calyx and buds green. Flowers white; tuber white, oval, with smooth skin, eyes on surface. Sprouts partly etiolated, red-violet.

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In order to help the determination of varieties we are presenting a summary of the typical distinguishing characteristics among the most prevalent and morphologically close to each other potato varieties. (Follow tables listing six groups of potato varieties p. 89-94) [Not translated]

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R56

Chernishova O.P., and L.B. Rozhalin

Moscow. Nauchno-Issledovatel'skii Institut Kartofel'nogo Khoziaistva. Semenovodstvo i aprobatsiia kartofelia (Production and certification of seed potatoes) Moskva, 1946. 207 p. 75 M858

Translated in part by
S. N. Monson

DISEASES AND PESTS OF POTATOES AND METHODS OF CONTROLLING THEM

Pdatoes are considered a versatile crop which grows in the most varied surroundings. But potatoes also react more than any other culture in the most drastic manner to the influence of a given enviroment.

If under a favorable combination of temperature, moisture, nutritious elements, and care the potato develops well and produces an abundant yield, the latter will be radically reduced or frequently entirely lost under unfavorable external conditions. In those instances parts of the changed or dead tissues appear in various shape and amount on the different organs of the potato plant. And sometimes the entire plant will acquire such deformed and abnormal appearance that it may be difficult to recognize it as a potato.

All these diseases which occur under the influence of unfavorable external enviroments are called NON-PARASITIC DISEASES. The disease caused by different live organisms, primarily fungi and bacteria, are named PARASITIC DISEASES. Parasitic organisms are inclined to settle on potatoes because they find here everything needed for their nutrition and development: a large amount of water, starch, sugar, nitrogen, phosphorus, etc.

Diseases affect both the above ground and underground parts of potato

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plants. Some attack only the foliage, others the tubers, the third attack both. The results of these injuries are losses in yields, the lowering of the seed taste and technological qualities of potato tubers.

It is rather difficult to estimate correctly the total amount in losses incurred from potato diseases in a people's industry since they vary depending upon many conditions, i.e. the weather, periods of the appearance of the disease, agricultural methods, varietal composition, the volume of measures undertaken to control the diseases, etc.

Consequently, the figures which determine the amount in losses from disease have to be accepted as approximate, without any claim to accuracy. USA statistics estimate their yearly potato losses from diseases at 19 to 26 percent; this does not include losses in storage. Mohrstadt estimates yearly potato losses in Germany at approximately 25 percent and the damage caused by pests 5 percent. The British literature states that losses of 30 percent may not be exaggerated. Schultz estimates Switzerland's losses to be 30-40 percent. In the USSR Professor A. A. Yachevski made an estimate of 30 percent for the yearly losses from potato diseases.

While the above data is not conclusive it still indicates that close to one third of the potato yield is lost every year from diseases and that their control demands our concentrated attention. At present simple and accessible measures have been worked out which permit to grow healthy potatoes and store it with least losses. Seed potatoes will require special attention. There are diseases which when they once occur and develop on plants not only reduce the yield of a particular season but react unfavorably

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upon the seed qualities of potato tubers and yields of succeeding years. Among these is the disease RING ROT, THE DISEASES OF DEGENERATION and others which attack tubers and remain concealed in the latter. Tubers having a hidden form of disease should be segregated; they are likely to get into the plantings and produce diseased plants of low yields. It is less difficult to recognize diseased plants from healthy ones in the field. Consequently, it is in this period that careful observation over seed potatoes has to be organized, and timely and essential measures introduced to prevent the disease from spreading further..

Only healthy seed material, a high agricultural technique, proper care and the timely introduction of methods of controlling diseases will offer every opportunity for securing good, healthy potato yields.

CHAPTER I - PARASITIC DISEASES OF POTATOES (FUNGUS DISEASES)

POTATO CANKER

Synchytrium endobioticum (Schib.) Perc.

Potato canker is prevalent in many countries. It is found in South Africa, Japan, America and Western Europe, including the countries bordering on the USSR: Finland, Rumania, Germany, Poland. There was no potato canker in the territories which were joined to the Soviet Union and which previously had belonged to Poland, Finland and Rumania; the Lvov, Drogobychski, Czernowitzy and Stanislavski oblasts, the Kamnel'yarvski territory, the Leningrad oblast. According to latest information canker of potato was discovered in the Kamenets-Podolsk, Brest and Bobruisk oblasts.

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Potato canker is a most dangerous disease in view of the ease with which it spreads, the difficulty of controlling it, and the considerable losses in yields it causes. On heavily affected plots losses in yield may be so severe that it is no longer possible to grow non-canker-resistant varieties of potatoes on them. The tubers affected by canker rot are unfit for use. When stolons are strongly affected/tubers do not form at all, in spite of the fact that the part of the plant above ground develops normally. It is necessary to pull the plant out of the soil and examine its underground part, as well as the stems and leaves which were in contact with the soil.

The disease develops chiefly on tubers and stolons; less frequently on stems and foliage, and never on the roots. Growths of irregular surface form on the affected organs of the plant, resembling in appearance heads of cauliflowers (see illustration No 20, p. 104). The size of these growths varies from those hardly visible to the eye to those larger than the tubers. At first they are of white or slightly yellowish color, gradually getting darker. Growths that form on the parts of plants above ground may also take on a green color.

According to observations made by many research workers, canker growths develop exclusively near the eyes of tubers. Weiss nevertheless describes an unusual form of canker appearing as scab-like crusts outside of the eyes of tubers. The canker growths after a time disintegrate into a spongy, warty mass or change into a slimy mass of offensive odor. Some disintegrate in the same autumn, others during storing and even in spring.

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The products of this disintegration contain an enormous amount of spores of the parasite and may serve as a source of infection.

The disease is caused by a fungus which has no mycelium and is called Synchytrium endobioticum. When inactive the body of the parasite consists of cysts which are also called winter dormant spores or winter zoospores. The cyst represents a rounded body of light brown color having a thick cover. The formation of winter spores takes place primarily by the end of the summer; summer spores form chiefly in the beginning of the vegetative period. Cysts are incapable of developing in the same year and remain for some time in a state of dormancy. The duration of this period depends upon external conditions (the presence of heat, moisture and oxygen) and varies from several months to several years. In contrast to summer zoosporangia which perish quickly under an unfavorable enviroment, winter spores are extremely resistant to unfavorable external conditions. They do not lose their viability for a period of five years under dry air conditions. According to data provided by Hille winter spores may preserve their viability for 13 years in uncultivated poorly aired soil, and according to the latest data, for close to twenty years. They are not harmed by passing through the intestinal tract of an animal and thus do not lose the capacity to grow and infect potatoes.

The infection of tubers takes place at a temperature of between 12° and 24° C., best at 15°. Moist years with temperate temperature are most favorable to the development of the disease. Uninterrupted cultivation of potatoes aids the accumulation of cysts in the soil and strengthens the

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disease. The development of the disease proceeds in various ways. The principal way is the infection of tubers transported into different localities, frequently great distances away. The second, most prevalent form for spreading the disease, is through infected soil. Manure may also become a source of infection since winter spores of the fungus do not lose their viability after passing through the intestinal tracts of livestock. The role of natural ways: wind, water, insects and birds is smaller, although one may not altogether discount their significance in this respect.

THE CONTROL OF CANKER POTATO is extremely difficult. Among measures well known in countries where the disease prevails are: crop rotation with potato crops alternating every 5 to 6 years; treatment with mordants of tubers and soil; the utilization of healthy seed material, the destruction of diseased material, etc.; all these are of considerable importance in treating and lowering the volume of disease but they do not eliminate it. A positive solution of the problem became possible only when canker-resistant potato varieties were introduced into cultivation. Among the canker-resistant varieties propagated in the USSR we shall mention: ERLICHINGEN, COUPIER, GREAT SCOT, KALEV, COBBLER, MAJESTIC, JUBEL, etc. On March 19, 1938, the Sovnarkom of the USSR directed the border oblasts, territories and republics to plant entire sowing areas with canker-resistant varieties along the fifty kilometer zone of the border belt. This represented a protective measure against the penetration and spread of canker into the territory of the Soviet Union. At present we are faced with the most important task of destroying the loci of canker disease in oblasts and regions freed from the German invaders and substituting canker-resistant varieties of

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for non-resistant potato varieties in the entire area. Along with an increase of the canker-resistant acreage, QUARANTINE MEASURES are essential. The importation of potatoes from ~~selections~~ sections where potato canker prevailed is strictly prohibited. All seed material entering the USSR is submitted to careful quarantine control. Seed material free of disease and pests of quarantine significance are planted in quarantine nurseries and hothouses where they are submitted to careful systematic observations for several years. Quarantine measures are absolutely essential. It is not possible, nevertheless to depend upon them alone. Along with quarantine control it is necessary to aim at the fastest propagation of already available canker-resistant varieties and the production of new canker-resistant potato varieties.

PHYTOPHTHORA

Phytophthora infestans D.B.

Phytophthora, the disease also called "potato rot", "potato disease", "late rot" has been known close to one hundred years. At the present time it is familiar to all countries where potatoes are grown, its spread being primarily confined to locations with temperate temperatures and abundant rainfall during the vegetative period. Since its appearance is connected with weather conditions, the disease develops sometimes in different locations in intervals of several years.

In the USSR the sections of strongest development of the disease are the Leningrad, Kalinin, Smolensk, Sverdlovsk oblasts, the White Russian SSR ("Belorussia"), the Siberian forest belt. In the Moscow oblast cases of

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strong outbreaks of the disease were noted in 1918, 1919, 1928, 1929, 1930, 1932 and 1934, a circumstance which points to its appearance in intervals of several years.

The disease occurs less and less frequently moving southward and is completely extinct in the steppes of the dry oblasts, increasing again in pre-mountain regions.

Phytophthora represents one of the most dangerous diseases. On some farms where there is a severe contamination of the foliage and tubers, yields of non-resistant varieties suffer a loss of 100 percent. Yield losses are connected with the premature dying of leaves and stems, as well as the affliction of tubers. N.A. Rozhdestvenski estimates that yearly losses as a result of phytophthora vary in various regions from 2 to 4 percent to 12-15 percent, and that the average loss for the Union represents about 10 percent.

Losses as a result of phytophthora in other countries are equally large. In parts of France over 80 percent of the potato yield was lost in 1916. In Germany in the same year the loss was 33 percent; in Switzerland losses reached 30 percent, in the United States about 8 percent.

In the potato plant phytophthora affects the leaves, stems, sprouts, flowers, fruits, tubers and stolons. In damp and cloudy weather brown wet spots of irregular shape appear on the leaves of diseased plants. (See illustration no 21, p. 106). At the borderline between the healthy and dead tissue of the leaf there is a grayish-white web film which is the principal characteristic of the disease. The latter disappears in clear

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and sunny weather and it is difficult then to distinguish the phytophthora spot from spottiness produced by other causes. In doubtful cases the affected part of the plant has to be transferred to a humid place. Under moist conditions the affected part, if caused by phytophthora, will after 12-24 hours produce the characteristic whitish film which consists of mycelium and the spores of the fungus. In the early stages of the disease the plants with dying blackened foliage are distributed in the field in low sections; subsequently the disease spreads over the entire field.

Phytophthora penetrates into the tubers through rainwater carried by the diseased foliage and stems; the tubers are frequently affected earlier. On their surface appear gray-white, hard, later depressed spots. One may see on a cut (sliced) tuber that the affected dead tissue of brown color penetrates from the surface to the pulp in the form of irregular protrusions and spots with irregular margins. (Illustration No 22 p. 107); a mass affliction of the tubers occurs during harvesting when they get in contact with the diseased foliage and infected soil.

The symptoms of the disease on tubers are not immediately noticeable and are recognized only some time following their infection. The duration of the incubation period depends upon external conditions. The more favorable the conditions for the development of phytophthora, the sooner will the disease be noticed. In the fall the disease usually appears on tubers two to three weeks after infection which occurs in mass during harvesting time. It is therefore essential to keep the potatoes in phytophthora years under constant observation for about one month from the time of digging.

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The beginning of the appearance of the disease depends to a great extent upon weather conditions and consequently periods of its appearance in various locations throughout the different years may vary considerably. The first ten days of July and August have been designated as the last periods of the appearance of the disease in the Moscow oblast in the years 1930-1934. In the pre-mountain regions of the Northern Caucasus the last periods of its appearance in the same years were also the first ten days of July and August. Instances have been known when in the Moscow oblast the disease began to develop by the end of August or early September, as was the case in 1940.

The inducer of the disease is a fungus called PHYTOPHTHORA INFESTANS; it has a well developed mycelium without partitions (?). The latter are frequently observed in a mycelium which lacks plasma. As the thread ("gifa") loses its protoplasm, this empty and dead part is separated by a partition. Phytophthora lives in the inner tissues of plants, penetrating into them through the lenticels, apertures ("ust'itsa"), and directly through the epidermis. The spores or conidia form on the surface of plants on special branched formations (growths?) of the mycelium which are called conidiophore (illustration no 23, p. 108). The latter usually comes out of the apertures or lenticels and carry lemon-shaped conidia. Eventually the conidia fall off. When they are in favorable conditions, they grow and penetrate into the plant tissues. For their growth conidia require a relatively high moisture in the air. Whenever conidia get into a drop of moisture, 6 to 16 zoospores are formed inside it. The zoospore crawls onto the surface through an opening in the conidia cover, moves for a while within the drop of moisture,

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then stops its movements, takes on a roundish shape, grows and penetrates into the plant.

The optimal temperature for the development of mycelium and the formation of conidia is within the limits of 19 to 22°C., the optimal temperature for the formation of zoospores 12 to 15°C. At reduced temperatures phytophthora forms organs of protection - roundish spores of thick cover named "zoospores". Phytophthora can winter in tubers that are stored and in the soil on vegetative residue.

The major methods for controlling phytophthora consist in the careful selection of healthy tubers for sowing and the introduction of proper crop rotation. It is also necessary to destroy the diseased foliage and all post-harvest residue. The diseased foliage should be gathered from the field three to five days prior to the digging of potatoes in order to prevent the tubers from infection in harvesting. The destruction of the foliage and post-harvest wastes is a difficult job but possible, nevertheless. The post-harvest residue may be dropped in a ditch, hole, or pit and covered with a layer of soil 40 to 50 cm. high. The foliage may be transported to a dumping ground, piled into small heaps for better airing and burned the following spring. The dug tubers must be dried. This should be done in well ventilated barns or under cover, or as a last resort, in bell-shaped piles covered with straw. It is not permissable to cover the dug potato tubers with leaves because these may infect the tubers with phytophthora, ring rot, and black leg.

The dug up potato tubers should be carefully watched. If two to three

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weeks after harvesting phytophthora spots appear on the tubers, the diseased tubers should be removed. To prevent the disease from developing in storage it is necessary to maintain a temperature of plus 2° C in the storage bins (deviating no more than one or two degrees either way) and an air moisture of 85-95 percent. The presence of moisture in drops on the walls and ceiling in storage bins indicates an unfavorable enviornment for storing.

A very effective remedy for the control of phytophthora is spraying during vegetative periods or dusting of potatoes with poisonous substances containing copper. For the spraying of potatoes a 1 percent Bordeaux mixture (1 kg. of copper sulfate to 100 liters of water and 1 kg of unslaked lime of good quality) is used. Copper sulfate and lime (previously slaked with a small amount of water) are diluted separately and poured together, the solution being mixed constantly. It is important that in pouring the liquids the solution of copper sulfate be of a weaker concentration than that of lime. No additional water should be added to the mixed solution. The dilution of both copper sulfate and lime should therefore be prepared in such manner that the entire necessary amount of water be used before combining. A properly prepared liquid has a milk-blue color and no residue. The prepared Bordeaux mixture should be put to use the same day because on the following day it is no longer suitable for spraying. Bordeaux mixture is poured into the sprayer through a strainer or piece of gauze folded 4 times to prevent the tips of the sprayer from becoming clogged. One application of spraying for one hectare of potatoes will require about 600 liters of Bordeaux mixture.

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The spraying of fields is begun at the first sign of phytophthora on potatoes in low and damp locations. During the spraying the liquid should pour from the tips of the sprayer in the form of a mist and evenly cover the plants. After the proper kind of spraying a thin, even, bluish film of residue is left on the plants when they dry, which remains for a comparatively long time. When the residue washes off a second spraying is applied.

The early, most valuable and the deficit ("deficitnie") varieties are sprayed first. If at the time phytophthora appears some variety is in the state of drying, spraying is useless.

The spraying with Bordeaux liquid may be substituted by dusting with AB powder during the same period. One application will require 15-18 kg per hectare.

The effectiveness of spraying with Bordeaux liquid in controlling phytophthora is confirmed by many facts. In America, in the state of Vermont, sprayed plantings of potatoes produced 263 units in yield as against 159 units from unsprayed plots. In the Netherlands spraying resulted in an increase of about 50 percent in yield. In Germany between 1928 and 1929 spraying increased the potato yield of early varieties 34.6 percent, of medium maturing varieties 13.7 percent and late maturing varieties 1.15 percent. Spraying of potatoes in the various areas of the USSR produced the following results. [See table 13.]

INCREASE OF YIELD OF POTATO TUBERS AS A RESULT OF SPRAYING WITH BORDEAUX LIQUID (according to data of IKKH for 1933)

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TABLE 13

Location of Spraying	Increase of yield in various varieties (in percent):		
	Early	Medium	Late Maturing
Moscow Oblast	8	10	10
Leningrad Oblast	20	7	7
Belorussian SSR	87	31	21
Siberian Forests	75	22	15

The increase in yield is caused by the fact that potatoes sprayed with Bordeaux liquid or dusted with AB powder are not infected by phytophthora or very slightly infected. The plants remain green until the end of the vegetative period and continue their increase in yield.

The thought of utilizing the plant itself for controlling phytophthora occurred almost simultaneously with the spread of the disease, i.e. about one hundred years ago. It was observed that different varieties of potatoes reacted differently to the infection by phytophthora and that the difference in the degree of infection was stronger on the tubers than on the foliage. Since that time many researchers have pursued and continue to pursue the task of producing varieties resistant to phytophthora. At first the known cultivated varieties were used for the purpose. When the wild tuber bearing species of Solanum, resistant to phytophthora were discovered, i.e. Solanum demissum, Sol. semidemissum, Sol. Antipoviczii, they were used as parents in crossings with cultivated varieties. At the present time several economically valuable hybrids have already been produced which are resistant to phytophthora. Nevertheless, it would be premature to discontinue the

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work with existing cultivated varieties. Many of them possess valuable economic qualities, are affected by phytophthora only in a slight degree and are preserved with a minimum of loss. Of much interest in this connection is the data of the Sverdlovsk Vegetable Potato Experiment Field for 1937. During a severe spread of the disease in that year not all varieties suffered in the same degree. [See table 14.]

It is also necessary to direct attention to the circumstances that the infection in the field of leaves of early maturing varieties occurred in the same degree and was evaluated by the highest mark, i.e. 3. In spite of this the varieties Epicure and Epron did not produce any diseased tubers in harvesting.

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Moscow. Nauchno-Issledovatel'skii Institut Kartofel'nogo Khoziaistva. Semenovodstvo i aprobatsiia kartofelia (Production and certification of seed potatoes) Moskva, 1946. 207p. 75 M858

Translated in part by
S. H. Monson

TABLE 14

INFECTION BY PHYTOPHTHORA OR DIFFERENT VARIETIES OF POTATOES; DATA OF THE SVERDLOVSK VEGETABLE-POTATO EXPERIMENT FIELD FOR 1937.

Name of Variety	Degree of Infection of Plants (ratings)	Infection of Tubers at Harvesting (percentage of)
Phytophthora-Resistant	0	0
Jubel	1	0
Lorkh	1	0
Centifolia	1	0
Parnassia	1	0
Wohltmann	1-2	0
Korenevski	1-2	0
Epicure	3	0
Epron	3	0
Courier	3	28
Cobbler	3	30
Snezhinka	3	48
Early Rose	3	49

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DRY LEAF SPOT (MACROSPORIUM SOLANI ELL., et MART.)

Dry leaf spot is also called macrosporium, alternaria, early potato rot. For a long time this disease was considered of little harm. There is, nevertheless, sufficient data to assert the reverse. According to American data the disease reduces the yield 25 percent. Other data points to the untimely dying of plants and their complete destruction even on irrigated plots.

Dry leaf spot seriously injures sprouts and our, as well as foreign selectors, call it therefore the scourge of selection. The disease affects potato leaves. Tubers get infected when they have a tender skin which easily peels off during harvesting. Dry spots of roundish-wavy shape appear on the leaves. Against the dark-brown background of the spots stand out concentric ("kontsentricheskie") rings, especially well seen on large spots. The spots, dispersed in disorder over the entire leaf surface, grow, unite, and lead to the complete dying of the leaf (see illustration 25, p. 114).

The diseased tubers have dark, almost black, slightly depressed spots on their surface which in some cases extend to one third of the tuber. As a rule, the spots do not exceed 1 cm. in diameter. When sliced, a dark-brown, dry, hard line of rot is seen through the spot, which penetrates 5-6 mm into the pulp of the tuber (illustration 25, p. 144). The tubers affected by macrosporium are exposed to attacks by saprophyte, fungi and bacteria, and decay completely.

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In the fields the disease usually appears in the middle or by the end of June and develops throughout the entire summer. It was observed that hot days alternating with warm rains and dewy nights create favorable conditions for the development of the disease. Dry leaf spot strongly affects potatoes during continuous cultivation. The plants frequently dry out on irrigated plots if affected by the disease. Dry leaf spot is spread primarily in the central and southern parts of the USSR, i.e. the Moscow, Kursk, Voronezh, Kharkov, Poltava, and other oblasts, but it is also found in such places as Pamir. and the Kola Peninsula.

To control the disease it is essential to grow potatoes in proper crop rotation and it is also necessary to gather and destroy the vegetative residue following the harvesting of potatoes. Positive results were obtained from the spraying of potatoes with Bordeaux mixture at the first sign of disease. The reaction to the disease of many varieties differs radically. The varieties Lorkh and Wohltmann are lightly affected by it, Early Rose and Phytophthora-Resistant are strongly affected.

POTATO WILT

Into this group belong diseases characterized by a general trait - the wilting of leaves and stems and their premature decay. Inducers are the fungi Verticillium albo-atrum Reinke and Berth and Fusarium.

WILT FROM VERTICILLIUM. This disease affecting potatoes prevails chiefly in the south-eastern and central parts of the USSR. In these localities it causes visible losses in yield. According to data provided

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by the Ulianov Experimental Station, average losses in yield of different varieties over a period of three years amounted to 26.8 to 40.3 percent.

The development of the disease is helped by a temperature of 20-23°C and the continuous, uninterrupted cultivation of potatoes. At first the margins of leaves get slightly yellow and individual leaves and lobes wilt. Almost simultaneously with the wilting, which grows more marked from day to day and spreads to new leaves and stems, the leaves begin to die when on their margins appear brown spots. Finally the stem or the entire plant decay. In moist conditions a thin, very tender, whitish film, consisting of the fruit-bearing bodies of the fungus, appears on the dead parts of the plant, first on the petioles. Wilting is frequently accompanied by the browning of the vascular burdles of the stem. In doubtful cases it is recommended to cut pieces off the base of the stem and place them in a damp room. If verticillium is present the characteristic tender, hardly noticeable film will appear in 3-5 days. The safest way to establish the disease is to examine the film under the microscope since it contains the fruit-bearing bodies of the fungus. One may equally examine the thin lateral cuts taken from the base of the stem. If affected by verticillium, the vascular and spiral rings of the stem are filled with mycelium (Illustration 26, p. 116). It was considered that verticillium was incapable of injuring the tubers. Some point to the browning of the ring and guided by this feature determine the infection of tubers. Other researchers, however, deny the dependence of this fact upon verticillium and claim that a high temperature and low humidity are capable of causing the browning of the vascular ring of the tuber. It is necessary to direct attention to the

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fact that the browning in the zone of the vascular ring is not connected with the decay of the tuber pulp and does not reflect upon the latter's economic usefulness.

In 1940, we first had occasion to observe the serious injuries caused to tubers and traced to verticillium. During the harvesting of the variety Korenevski severely affected by the disease, pink spots were observed on the eyes of many tubers. During storing the pink coloring disappeared and was replaced by decaying tissue and a blackening of buds. When the tuber was sliced through the injured eye, glass-like, yellowish and also hard lumps of pulp were found in the area of the vascular bundle. In some cases a depression formed in place of the former eye as a result of the complete decay of the tissue. The decay penetrates deeply into the tuber where the pulp changes into a fine dry gray powder.

Verticillium winters in the soil on vegetative residue. It remains there until the next season when it penetrates into the vascular tissues of the plant through the small rootlets. From the stems the fungus passes through the stolons into the young tubers. Because of the viability of the parasite the plant wilts and dries out prematurely .

The affected tubers usually do not have any evident symptoms of the disease that may distinguish them from healthy tubers. They therefore invade sowings and transmit the disease to new plants. According to the Ulianovski Experimental Station, tubers of diseased plants transmit the disease/72.9 percent over a period of two years. In plantings of tubers from healthy plants on plots of uninterrupted cultivation of potatoes the infection amounted to 100 percent. Thus the spread of the disease goes two ways:

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through the tubers and through the soil. According to Wollenweber, verticillium infects some 60 species of plants of various families which include peas, tomatoes, Cucurbitaceae, beets, saltbush, spindle tree, raspberry, linden tree, maple, etc.

In spite of the fact that verticillium has such a wide circle of plants to feed on, the principal method of controlling it is through proper crop rotation. The best predecessors for potato crops will in this case be grain cereals. Numerous researchers confirm the healthful influence of crop rotation. We submit here average figures obtained at the Ulianovsk Experiment Station covering a period of two years. [Table 15]

TABLE 15

INFECTION OF POTATOES BY VERTICILLIUM AND ITS CONNECTION WITH CROP ROTATION
(data provided by the Ulianovsk Experiment Station for 1939-1940.)

Crop Rotations	Percentage of Diseased Plants
Uninterrupted Cultivation of Potatoes	91
3-field crop rotation	25
4-field crop rotation	15

Healthy seed material combined with proper crop rotation during which potatoes are not returned to the same location any earlier than every three years eliminates verticillium. Of much significance in controlling this disease is the cleaning of diseased plants, the gathering and destruction

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of the infected foliage. It is necessary to point to the positive influence summer plantings have upon the sanitation of potatoes and their preservation from verticillium; this influence shows not alone in the first year of planting but also in the next. Data gathered by N.I. Kharlamp*eva in 1939 indicates the disease did not prevail in plantings after July 5th. In 1940, potatoes of the previous year of different periods of plantings were sowed on the same day, May 10. Potatoes of July plantings of the preceeding year proved healthiest. [See table 16, p. 118]

TABLE 16

THE INFLUENCE OF PERIODS OF PLANTING UPON THE PROTECTION OF POTATOES FROM VERTICILLIUM (data of N. I. Kharlamp'eva for 1939)

Infection by Verticillium in 1940	Periods of Plantings in 1939							
	May		June			July		
	14	25	5	15	25	5	15	25
Percent of wilted plants	92.5	87.5	80.0	49.0	64.0	57.0	12.0	0
Percent of tubers with hose coloring on eyes	31.0	22.0	20.0	14.0	14.0	5.0	1.0	0

As to the resistance of varieties to verticillium, observations concerning their conduct under natural conditions and under artificial infection tell of a diversity in their reaction to this disease. The varieties Hero, Rubia, Krüger, Lorkh, Wohltmann are affected only lightly; the varieties Korenevski, Phytophthora-Resistant, Epicure, Early Rose, Merker and others

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are strongly affected

WILT FROM FUSARIUM. Fusarium wilt of potatoes is spread primarily in the southern USSR, in locations of high temperatures. It is considered one of the most dangerous diseases in the USA and southern parts of Europe. Potato wilt in southern USSR is reported from the Crimea, Northern Caucasus, the Rostov oblast, the Ukrainian, Kazakh and Kirghiz SSR. The causes for wilt in the south have not as yet been sufficiently determined.

It is necessary to mention potato wilt which in recent years (1937-1940) has reached enormous proportions primarily in June sowings in the Stavropol territory, the Rostov oblast, and in the Crimea. This type of wilt is extremely harmful and in some cases completely destroys the harvest. Its distinguishing characteristic consists in that it affects the early periods of summer plantings (June) and that the disease proceeds at a rapid pace. It develops most severely with the coming of hot weather following a period of rains. Severely attacked are strong, healthy, well developed plants which rapidly wilt and decay.

According to a description provided by M. B. Borduikova, wilt begins in August, at the time the potatoes are in the blooming stage, quickly spreading over the entire plant. The leaves dry out, in spite of the absence of any spots on them. Occasionally only separate stems wilt but more often the entire plant. The underground part of the stem and the root system decay, the side rootlets and stolons frequently acquire a brown coloring. Tubers get flabby. Ten days after digging the tubers harden, slice with difficulty and show dark spots on the cut which are distributed

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along the ring and the entire surface of the cut. The stems and tubers of wilted plants discharge the fusarium; the role it plays in the development of the disease, however is not known. Two points of view prevail concerning this disease. Some believe that wilt and the destruction of the root system occur under the influence of unfavorable soil conditions; high temperature and humidity, the lack of air in the soil, and that fusarium, as discovered in diseased plants, is not the cause but the consequence of the disease. Other students claim that fusarium represents the basic cause of the disease and that high temperature and moisture of the soil are only conditions activating its large scale development.

In controlling this disease the optimal period of summer plantings, established experimentally for each territory and oblast, is of decisive significance. For the Stavropol territory the optimal period of summer plantings lies in the period of July 5 to 15. The data provided by the Voroshilov Station (table 17) supports this claim. The second important measure is the introduction into cultivation of resistant varieties. In 1940, all varieties at the Voroshilov Station were attacked by wilt, while the seedlings of the Institute of Potato Industry, No. 2086 and 9720, stood out by the light degree of their affliction.

In the Ukrainian Polessie Fusarium Wilt is rather widely spread, differing radically from the wilt described above. According to the description provided by O. D. Belova, wilt of plants occurs very rapidly in the course of one or two days. It is accompanied by a severe reduction in yield. This reduction is greater when the wilting occurs early. The

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diseased plants are distributed in the field in loci. A small section of the stems will get brown and soften at a height of approximately 10-20 cm. On this brown part develop rose fruit-bearing bodies of the fusarium fungus. Stems break at these sections, fall off, and rapidly decay. The disease is observed on young plants without tubers, as well as on mature plants with tuber formation. In the Moscow oblast wilting was first observed by O. D. Belova in 1943. It was noted on the variety Courier in two loci of 60 to 70 plants each. Methods for controlling the disease have not been worked out as yet.

RHIZOCTONIA SOLANI KUHN

Rhizoctonia is a widely spread potato disease. In the USSR it occurs primarily in central and northern sections. It is strongly developed in the Leningrad, Murmansk, Voronezh, Omsk, Novo-Sibirsk oblasts and the Kazakh SSR.

The disease appears in the most diverse forms. In potatoes it affects tubers, sprouts, roots, stems, stolons; the young sprouts and roots being infected most frequently and in greater degree.

In tubers it is known to appear during dormancy in the form of sclerotia, which are spread in disorder over the surface. Sclerotia consist of hard, dark lumps resembling clinging lumps of soil, but less easily crushed; they may be picked from the surface of tubers with relative ease. Rhizoctonia may produce decay of tubers. The young or elongated tubers rot first, their pulp gets transparent, devoid of starch. At first the pulp of an infected tuber is grey and gradually it takes on a brown coloring. Tubers affected by rhizoctonia sometimes

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produce depressions and cavities. Rhizoctonia penetrates into the tuber through lenticels. The tuber reacts to this invasion by forming a "cork" which dontinues its formation as the pulp disintegrates. In dry conditions the content of the affected spot dries out and a cavity is formed. In some cases the affected spots meet and then a considerable area is destroyed on the tuber. The dead tissue may drop out and form depressions when the tubers are dug. Tubers from which dead tissue has been eliminated have the deceptive appearance of having been affected by deep scab or insects. Brown pustules of different size and depth form in the injured spots, the sprout dies and in its place, somewhat lower, a side runner is formed which in turn is also affected by rhizoctonia. The entire energy of the sprout is spent upon the formation of side runners, as a result of which plants do not grow at all or their growth is delayed and their size stunted. Whenever sprouts are affected, yield losses reach 15-20 %.

Aside from sprouts, the young roots, rootlets, hairs and stolons on the above-ground part of the plant are also injured. brown pustules appearing on them. When the stem is severely injured and the vascular system destroyed, plants wilt and dry out prematurely. Most of the time stems suffer but slight injury. In those cases the stems thicken, form aerial tubers, their upper leaves get pale and slightly rolled, unite and form a rosette. During the summer in moist weather or on crowded plots one may frequently observe close to the base of the stem above ground a grey-white felt-like (matted) film. This stage of the fruit-bearing bodies of the fungus is the least harmful form of the disease. The state of fruit-bearing is called Hypochnus solani Pr. et Del. Rhizoctonia severely

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affects potatoes on heavy soils. It injures potatoes in lesser degree when the latter are in optimal conditions of growth. Among measures meeting the indicated needs are good cultivation of the soil, vernalization, the introduction of manure fertilizers in combination with mineral fertilizers, the sowing of potatoes in optimal periods, the harrowing of the field prior to germination.

Rhizoctonia affects many species of plants and viewing it in this connection one may assume that crop rotation may not be of much significance in controlling the disease. Observations indicate, however, that when potatoes are rotated in the same location every three to four years, the yield is affected less.

Along with crop rotation, planting with selected (certified), healthy tubers carries much significance in combatting the disease. A large amount of data points to the efficacy of selection. In plantings with healthy certified tubers the yield is increased and disease reduced. When on the Kaluga Agricultural Experiment field healthy tubers were planted in 1940, the yield was increased 29% as compared with the yield from tubers severely infected by sclerotia. [Table 18]

TABLE 18

RELATION OF POTATO YIELD TO THE DEGREE OF TUBER INFECTION

(Data of Kaluga Experiment Field for 1940)

Degree of Tuber Infection in Planting	Yield in °/o
Tubers healthy, without sclerotia	100
" lightly infected by sclerotia	95
" medium " " "	88
" severely " " "	71

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In locations where the disease causes severe injuries, it is important not to delay the harvesting of potatoes. Tubers that remain in the soil for a long time are more severely infected; healthier potatoes are obtained from an early gathering.

DRY ROT OF POTATO TUBERS

Dry rot of potatoes is also called Fusarium. The disease is widely spread and known in all countries. It develops during the storing of potatoes and causes large losses. The degree of loss depends upon harvesting and storage conditions and the condition of tubers. According to data for 1933-34, the development of dry rot among stored potatoes varied from 0.5 to 13.7% in 16 territories and oblasts of the USSR. N. S. Perepelitsin estimates the average losses throughout the Union for ten years at about 10%.

At first there appears on the tuber a brown, soft, depressed spot. It expands in width and depth; the skin gets wrinkled. Tufts of white, yellow, rose and other colors appear on the spots. These are the fruit-bearing bodies of the fungus which consists of a firm interlaced mycelium and a mass of sickle-shaped spores. If cut through the decayed spot, the tuber shows brown pulp. Decayed pulp invariably develops hollow pockets lined with a mass of fungus growth of varied color. In damp conditions the fungus develops strongly on the surface of potatoes, enveloping the tubers as would cotton. (See illustration 28, p. 124). The disease was until lately ascribed to one species of Fusarium, Fusarium solani. In 1910, following the appearance of the works of Appel and Wollenweber,

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several species were distinguished in the group. In the USSR we find Fus. sulfureum, Fus. sambucinum, Fus. culmorum. It is possible that there are other species since work concerning them is not completed.

On the basis of its biological characteristics, fusarium is an early ("ranevy") parasite. Its conduct is that of a parasite which develops on the living tissue of tubers. On the other hand, fusarium, as does a saprophyte, adapts its development to the infected areas of tubers because it is incapable of penetrating uninjured skin. Fusarium penetrates into tubers only through the injured parts caused by phytophthora, ring rot, scab and other mechanical means. According to American data, the damage of tubers by fusarium (caused by bruises and cuts) is twice as high as that from phytophthora or other diseases. Some species of fusarium occasionally succeed in penetrating uninjured tuber skin in conditions of high humidity and drastic change in temperature. The degree of susceptibility of tubers to the disease varies during the storage period. It appears that under normal conditions of storing fusarium reaches a stronger development beginning early in March, i.e., in the last storage period.

Dry rot is caused by several species of fusarium, the environmental demands of which vary correspondingly; the disease is capable of taking its course within rather wide limits of variations in temperature and humidity. For the majority of species an optimal temperature of 10-20°C is required, but some of them do not stop in their growth at 0°; Fus. culmorum grows even at minus 5°C. At 25°C the development of most species of fusarium stops. While the development of some fusarium species takes place /

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at lower degrees of temperature and moisture, it proceeds very slowly and does not present a serious threat. Temperatures from plus 1° to plus 3°C. and relative humidity 85-93 % contain the development of fusarium in storage, and the maintenance of these conditions is therefore essential for reducing losses from dry rot.

One may not achieve tangible effects, however, by regulating temperature and moisture in cases where the tubers intended for storing have already suffered some injury. It is necessary to exercise the most meticulous care in all work connected with potatoes and avoid causing the tubers any damage. Bruises and cuts are particularly conducive to the development of fusarium. To protect potatoes from injuries, it is advisable to eliminate unnecessary hauling. One should not dump potatoes from any height or throw tubers with force or step on them in heavy footwear. Damaged tubers, if noticed prior to storing, should be segregated. Tubers infected by phytophtora and severely damaged by scab should not be stored. Only healthy, uninjured potatoes, meeting standard specifications, should be placed in storage bins. Tubers having tender skin should after they are dug be carefully piled and dried to permit the skin to toughen and possible injuries to dry out. Drying should generally be considered an essential because it produces conditions unfavorable for the penetration of fusarium into tubers. Drying should be done in the wind, under covers, or in barns, in places protected from the sun. The drying of freshly dug potatoes, especially those with undeveloped skins, in the sun for a period of two to three days leads to burns which, as do other injuries, result in the rotting of tubers from fusarium. Cases

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are known when tubers injured by the sun during harvesting in August or early September were subsequently destroyed by dry rot 30-40 %. It is equally necessary to protect potatoes from freezing.

The problem of varietal resistance to fusarium has not yet been explored. Research is complicated partly because of the diversity of potato varieties, partly because of the varied composition of fusarium species. The limited data obtained by the Institute of Potato Industry and other practical observations led to the claim that the varieties Epicure, Jubel, Wohltmann and Parnassia are relatively resistant to dry rot, and that Early Rose and Sovietski are strongly susceptible to fusarium.

POWDERY SCAB

Powdery scab, caused by Spongospora subterranea (Wallr.) Lagh.(John) is found in many countries. Data available in the USSR indicated a limited development of the disease and this circumstance led in 1931 to the establishment of a quarantine. Following some widely conducted observations it was established that powdery scab is spread in many parts of the Union and that its areas usually coincided with those of phytophthora. Under those circumstances the continuation of a quarantine was considered unpractical and in 1938 powdery scab was eliminated by a decree of the NKZ of the USSR from the list of parasitic diseases under domestic quarantine.

Powdery scab is considered a most harmful disease in the USA and Canada. In the USSR it is spread in the Armenian SSR. According to data provided by Petibridge, one third to two thirds of a yield is lost

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in the courseof four years under uninterrupted cultivation of potatoes. Tubers, severely affected by powdery scab, are unattractive in appearance, lose their commercial value and are unsuitable for storing. Powdery scab injures potatoes chiefly during a combination of the following factors: cool weather, especially during the first part of the season, medium or abundant rainfall in the same period and heavy soil. Optimal temperature for the spread of the disease is around 15°C. Heavy and humus soils contribute to the development of the disease.

Powdery scab affects the tubers, stolons and the underground parts of the potato plant, and in contrast to potato canker, it injures the roots. The early stage of injury on tubers shows in small, brown, more nearly circular (up to 1.25 mm in diameter) spots on which stand out brownish veins that appear more visible on the surface of the tubers when the skin is carefully removed. Subsequently smooth, small tubercles form on the tuber which in their central part preserve the brown coloring with the characteristic veining under the skin. The tubercles are of roundish shape and hard to the touch. They are 5 mm. in diameter and 2 mm. in height. The periderm of the tuber is torn eventually, its fringes roll outward, producing an open pustule. The latter is filled with a brown, powdery mass consisting of an accumulation of lumps, the spores of the parasite. Tubers just dug have pustules appearing like light, watery growths of uneven surface which resemble to some degree the growths of potato canker. When the tuber is left in the open for some time, the pustules darken, fall off, take on their usual appearance and no longer resemble growths of potato canker. During winter storing

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the parasite preserves its capacity to develop in the tissues of the tuber, as a result of which these are further destroyed and depressions formed in the tuber.

On the roots, stolons and stems powdery scab produces gall-like growths of different shape and size (see illustration 29, p. 127). The growths are at first whitish, then darken and fall apart. Towards the end of the vegetation period the formation of gall-like growths stops. Along with the growths small brown spots are observed which gradually swell and burst. A crack follows corresponding to the open pustule on the tuber.

The inducer of the disease, Spongospora subterranea, has no mycelium and spends part of its life in the plant's tissues (see illustration 30, p. 127). The formation of spores and spore knots takes place there. The knots consist of small angular spores and are pierced by cavities. Mature knots are colored either light olive or brown; when the tissues of the tubers or plant are destroyed, they get into the soil. Under favorable conditions spores grow and each produces an amoeba. Under unfavorable conditions the amoeba, with a thick covering, changes into a cyst and goes into a state of dormancy. The viability of spongospores in the soil may last five years.

Spread of the disease occurs through infected seed material, soil, agricultural equipment and other articles. Manuremay also become the source of infection since spores do not lose their viability after passing through the intestines of animals (livestock).

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Of major importance in controlling the disease are prophylactic measures: adequate crop rotation with potatoes returning to the same field after four or five years, the planting of healthy tubers, drainage and the drying of soils having too much moisture.

There are no varieties resistant to powdery scab, although some are affected lightly and others more severely. The lightly affected varieties are: Jubel, Cobbler and Parnassia. Among the severely affected: Epicure, Smeshinka, Early Rose. The varieties Wohltmann, Smyslovski, Lorkh and Korenevsky occupy an in-between position.

COMMON POTATO SCAB

Scab is a common disease in all countries producing potatoes. In the USSR its strongest development is observed in the Murmansk, Kalinin, Yaroslavl, Tambov, Cheliabinsk, Sverdlovsk, Omsk, Yakutsk oblasts, the Bashkir ASSR and Kazakh SSR. In some cases scab is hardly noticeable and not given any consideration, in others it forms an entire crust and deforms tubers. The latter, when strongly infected by scab, reduce the taste, seed and commercial qualities of potatoes. In America it is considered that loss from scab reduces the yield of seed potatoes 20-25%. Data of the Kaluga Experiment Field indicate that planting tubers strongly affected by common scab reduced the yield 39%.

Scab of potatoes affects tubers, occasionally stolons and roots. It develops on tubers in the form of ulcers of diverse form and size. These ulcers (pustules) form on the surface of tubers during the

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latter's growth. While the tubers grow the skin bursts; in place of the burst skin a "cork" layer is formed. On tubers that have stopped growing or tubers separated from the stolon and stored in bins in time, there is no scab; nor does scab develop during the storing of potatoes. The pustules (ulcers) appear as flat, deep, and protruding scabs. Scab on stolons appears in the form of elongated, brown cavities covered by a "cork."

A series of conditions contributes to the development of the disease. A temperature of 22 to 25°C and moderate moisture are favorable. Abundant rainfall, as well as abundant irrigation (watering) restrain its development, according to observations. In the vegetative experience of the Institute of Potato Industry, conducted on a severely infected field, the highest degree of infection of tubers occurred at a relative moisture of 60% [Table 19]. The degree of infection was estimated in ratings: 0 - no infection; 1 - slight infection; 2 - medium infection; 3 - severe infection.

TABLE 19

DEGREE OF POTATO-TUBER INFECTION BY COMMON SCAB IN RELATION TO MOISTURE OF SOIL (Data of IKKH for 1940)

Variations of Experiments	Yield per plant in hectares	Average degree of infection in ratings
Relative moisture of soil 20%	109	1.94
" " " " 40%	167	2.12
" " " " 60%	179	2.84
" " " " 80%	267	1.96

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Scab develops more on sandy soils than on swampy or heavy soils. The physiological acid fertilizers, if applied systematically, reduce the spread of the disease; fresh manure, especially if cultivation of potato is uninterrupted, increases it. The application of manure, in combination with mineral fertilizers in crop rotation, does not affect the development of scab.

A strongly active factor is the introduction into the soil of lime which considerably increases the disease on the third or fourth year after liming. The developing of scab proceeds slowly, reaches its highest point and remains on that level for decades.

According to observations of the Institute of Potato Industry (IKKH), scab developed on limy soils in 1939 and 1940 as follows [Table 20]:

TABLE 20

THE DEVELOPMENT OF SCAB OF POTATOES ON LIMY SOILS

(Data of IKKH for 1939 and 1940)

Variations of Experiment	Average Degree of Infection of Tubers	
	1939	1940
Without lime	0.02	0.22
Liming in 1938	0.45	1.34
" " 1937	0.29	1.43
" " 1936	1.83	2.32
" " 1935	2.14	2.53
" " 1934	2.72	2.35

On old limy plots (1934-1936) the disease reached its highest level, the above figures coming close to the maximal degree of infection, i.e.,

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the rating "3"; on plots that remained unlimed the yield of tubers proved almost healthy throughout. On naturally limy soils (carbonate), as against artificially limed, a slight development of scab was observed.

Research on the relationship between the pH on the degree of tuber infection indicated that at a pH up to 4.80 there is no scab even among very strongly non-resistant varieties. According to some American data, pH above 8 stops the development of the disease. Noll (Knoll) considers that the amount of pH does not influence the degree of infection by scab. In variations of the pH within the limits of 5.06 to 6.80, instances of very slight, as well as very severe, infections by scab were present in equal amount.

The disease is transmitted through the soil and tubers, chiefly through the former. Diseased tubers when planted on non-infected soil produce, as a rule, healthy yields. Soils, however, where scab prevails produce yields infected by scab from year to year, even if planted with healthy tubers. Such soils are difficult to reclaim and in American practice are valued accordingly much lower.

The transmission of diseases through tubers and the skin of diseased tubers introduced into the soil indicates the parasitic character of the disease. Aside from that, microorganisms called actinomyces, otherwise named light fungi, were frequently segregated from the pustules (ulcers) of diseased tubers. In 1941 the Institute of Potato Industry segregated 14 races (Stämme) of actinomycetes. These organisms were introduced into disinfected soil along with plantings of healthy, treated tubers. In all

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cases, except one, the tubers were infected by scab in a severe degree, while the potato yield on control plants remained healthy.

In spite of the age of the problem and the vast amount of work conducted on common scab, there are today no completely effective measures of controlling this disease on heavily infected plots. It is therefore essential that a severe infection of the soil by common scab be prevented by applying adequate agricultural techniques. The following measures should be undertaken in this connection: Planting with selected, healthy tubers, growing potatoes under proper crop rotation, application of green fertilizers, introduction of manure in combination with mineral fertilizers. On heavily infected soils it is recommended that acid fertilizers be applied in addition to the above, i.e., super-phosphate, ammonium sulfate.

Judging on the basis of facts we possess concerning the disease, one is obliged to reach the conclusion that the principal direction for controlling it should be along the path of producing and propagating resistant varieties. Our observations and experiments indicate that Jubel and the early-maturing seedling 1883 of the Institute of Potato Industry possess relative resistance to scab. Foreign sources consider the variety Carnea to be immune; the varieties Jubel, Hindenburg, Ackersegen practically resistant; the varieties Akebia, Berlichingen fairly resistant.

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LESS DISTRIBUTED AND LESS HARMFUL DISEASES

Powdery (?"Floury") mildew (Erysiphe solani Van) is widely spread in some years in the Rostov oblast, the Crimea and other southern areas. The leaves acquire a greyish-white downy film which causes them to die gradually, and the plant to dry out prematurely. Potatoes may be protected from this disease by spraying with sulfur. In addition, diseased foliage should be destroyed and potatoes grown in crop rotation.

Cercospora concors Sacc., also called yellow spot of foliage. Cercospora is widely spread but not harmful since it develops primarily on mature leaves. At the end of the vegetative period yellow and dark spots appear on the top surface of the lower leaves. The bottom part of the leaf is spotted dirty grey or dirty violet, resembling rain smudges. Control not developed yet.

Solerotinia sclerotiorum Perc. is a disease seldom affecting potatoes. In single instances it was observed in the Leningrad and Voronezh oblasts, the Northern Caucasus and the Belorussian SSR. Stems when affected wilt, decay and break off. Sclerotia forms inside the stem. If affected, tubers also decay. The decay is white, has no odor, discharges liquid; in time hollow cavities form in the decayed flesh and sclerotia are formed. High temperature encourages the development of the disease.

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CHAPTER II - PARASITIC POTATO DISEASES (BACTERIAL)

RING ROT OF POTATOES

(Corynebacterium sepidonicum Sp. et Koht.)

Ring rot when it infects the above-ground part of a plant is called bacterial wilt. At present it has been established that this is a widespread potato disease. In the USSR it is found primarily in the Central and Northern part of the Union.

Up to 1937 we had but little information concerning the harmfulness of the disease. It was considered that it affected potato sowings not in excess of two or three percent., except in few instances. In 1937 a mass outbreak of the disease was observed in many sections of the country: in the Moscow, Ivanovsk, Voronezh oblasts, the Chuvash ASSR, etc. Some varieties suffered losses of 50 to 70 percent. The decay of potatoes begun in the field continued in storage. In some cases decay amounted to 50 percent. and more. American data for the same period also refers to a severe development of the disease and the heavy damage it caused. Leach refers to the extreme rapidity of its spread, especially in 1937 and 1938. He directed attention to the severe damage which threatened yield losses of 100 percent.

Ring rot produces the decay of tubers and wilting of plants in the field. The causes of the disease are bacteria called Bacteria sepedonicum. Ring rot is transmitted through seed tubers and not transferred from plant to plant in the field. Nor does the soil act as a source of infection. The rapidity with which this disease progressed was truly amazing and difficult to understand. Traces of the disease in seed potato, as observed during the season, reached 15 to 40 percent. in the

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following year. This fact was inexplicable since only one form of ring rot was known until then.

Ring rot in its early stage may be seen only by slicing the tuber (see illustration No. 31, p. 133). The vascular ring becomes yellow or light brown in spots, and crumbly. Gradually these spots involve other tissues of the tuber which frequently unite and form a complete ring of rot. The early cream color of decaying tissue changes to white, then grey or brown. By that time cavities may form on the surface of the potatoes; the tuber acquires a dirty coloring, frequently spread in spots. In some cases the heart of the tuber decays, leaving an empty shell with a small layer of flesh. Under normal storing conditions the decay is odorless, soft, does not discharge any liquid or slime; under damp conditions wet rot will develop.

In 1937 O. D. Belova discovered a new form of ring rot, never described before, which she named HOLE ROT. It was observed that tubers of some varieties had decayed holes in their surface. As established later, the early stage of the hole decay was hidden in the tubers which did not differ from healthy ones. The hidden form of hole rot may only be noted by peeling off the skin (see illustration No. 32, p. 134.) Roundish yellow spots of mushy consistency appear on the cleaned white surface of the tuber. Piercing the tissue slightly with the tip of a knife easily establishes the healthy and infected areas of the tuber. Spots vary in size depending upon the stage of the disease, ranging from a pinhead to 1 cm. in diameter. The skin in the infected area ruptures and initiates the second cycle of organisms, specifically, the inducers

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of dry rot or black leg. Under the influence of these organisms the yellow coloring turns into grey or brown, the process of decay is accelerated and a hole is formed. Decayed spots are chiefly located in the upper part of the tuber or close to the eyes where the skin is thinner.

An entire series of work conducted by the Institute of Potato Industry and at the bacterial laboratories of the VIZR established a complete dependence between internal ring and exterior hole rot. The identity of these two forms of disease was proved by the exuding of the Bac. sepedonicum from the infected areas of the tuber into clean culture and the obtaining of a similar picture of the infection by numerous artificial infections.

Tubers affected by a hidden form of the disease, such as external hole and internal ring rot, get into the planting plots along with healthy tubers; depending upon the degree of their infection and external conditions they produce either one or the other picture of the disease in the field. Severely infected tubers decay in the soil and never come up. Where not all eyes in tubers are infected, dwarf plants come up which perish soon. Some diseased tubers produce low plants with thickened stems, shortened inter-nodes, raised and lightly rolled leaves. During the blooming period the leaves and stems of these plants wilt and dry out prematurely. Finally, if the tubers are lightly infected, plants of normal development may grow which up to blooming time do not differ from healthy plants. Towards the end of the blooming period the leaves and stems of infected plants begin to wilt. Stems usually droof and fall simultaneously (See illustration No. 33, p. 135.) The drooping and falling of wilted stems is characteristic

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for bacterial wilt. In fungus wilt leaves droop but the stems preserve their erect position.

When the infection is of a light nature, it is sometimes difficult to establish the cause of wilt. In doubtful cases one may use the microscope. The stem under suspicion is pulled out, the soil clinging to it washed off and thin diametrical slices are made on it from the root neck(?) upwards. One should attempt to include on the slide the vascular knots appearing in the form of whitish or yellowish points in the green tissue of the stem. In cases of bacterial wilt in the vascular rings and spirals a mass of bacteria is observed under the microscope which prevents admission of light to the vessels by a granular, cloudy or yellowish film. Occasionally the mass of bacteria is gathered only in a part of the vascular ring, close to its wall.

With respect to bacteria, wilt is always accompanied by the decay of tubers which starts in the field under the plant. The decay of tubers of the new harvest takes place through the stolons of the diseased plant, which in turn was infected by the maternal tuber. When bacteria, penetrating into the young tuber through the stolon, destroy the vascular system of the tuber and the fleshy areas which closely adjoin it, a typical ring rot is formed. In some instances the bacteria penetrate from the stolon into the core of the tuber, producing decay. Occasionally one may find completely decayed tubers under a plant.

The mass infection of tubers by hole rot occurs during the gathering of potatoes in damp weather. Of particular severity is the infestation of immature tubers with undeveloped skin. Ring rot is contagious and trans-

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mitted to healthy tubers by mere contact with diseased foliage, decayed tubers, infected hands and containers. In ordinary storage conditions the disease develops slowly. Tubers infested in the fall during harvesting do not exhibit any signs of hole rot until April. In April the disease begins to advance: spots under the skin extend in width and depth and at high temperature and humidity turn into cavities (holes).

In order to determine the degree of infestation of seed potatoes by hole rot, it is necessary to make an analysis of the tubers by removing their skins in the spring (in the Moscow oblast in April or May.) To determine the degree of ring rot infestation the same tubers have to be sliced in half. If such determination has to be made at an earlier date, in February or March, tubers under test should be kept at 15-18°C for 45 to 50 days and an analysis for both ring rot and hole rot made.

External conditions, temperature and moisture in particular, play a considerable role in the development of the disease. Bacteria sepedonicum, the inducer of ring rot, develops best in pure culture at 20-25°C. Intense wilt and decay of tubers in the field occur in low and damp locations or when there is rainfall during the period of potato tuber formation. Tubers get infested by hole rot under moist conditions, a fact confirmed by O. D. Belova under conditions of production. [Table 21].

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TABLE 21

EFFECT OF WEATHER CONDITIONS IN HARVESTING ON POTATO TUBER INFECTION BY HOLE ROT

Name of Variety	Percent. of hole rot on tubers	
	Spring 1938 following rainy fall	Spring 1939 following dry fall
Early Rose	25.0	0
Phytophthora-Resistant	23.0	0
Sovietski	50.0	0
Silesia	50.0	0
Smyslovski	48.0	0

The harvesting of potatoes in the fall of 1937 was accompanied by rainfall. In the spring of 1938 hole rot was observed in considerable quantity on potatoes. Moscow oblast had practically no rainfall in the fall of 1938; potatoes were gathered in dry weather and no hole rot was observed on potatoes in that region in the spring of 1938.

Observations made in production confirm the experimental data. Among other conditions affecting the development of ring rot it is necessary to refer to the slicing of planted tubers. Cutting of infected potatoes increases the disease. In American experiments knives and hands infected by ring rot prior to cutting, transmitted the disease to plants grown from the first eight cut tubers. In the experiments made by O. D. Belova, the varieties Early Rose and Phytophthora-Resistant produced 1.5 and 1.3 percent. of wilted plants from the sowings of whole tubers and 9 and 10 percent. of wilted plants from sowings of cut tubers.

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Knowledge accumulated in recent years concerning the manner in which ring rot spreads and the conditions under which it develops permit us to approach the solution of the problem of methods designed to control the disease. To begin with, systematic control of seed potatoes is essential, consisting of inspection of plantings in the field and the inspection of potato tubers in the fall and spring. Inspection of tubers in the fall -- to establish the infection of seed potatoes by ring rot, in which case the tubers are sliced in half; and inspection in the spring which determines the degree of infection in tubers by both the internal and external forms of ring rot. Tubers are first peeled, then sliced. Groups of potato tubers that are least infected as compared with the standard established for seed potatoes are selected for planting. If tubers affected by ring rot are discovered in groups of potatoes, these should not be cut for sowings. Only healthy potatoes may be cut, this operation to be performed best in the field on the day of planting, when cut tubers are placed directly into the container from which the planting is done. Cut tubers should not be dried in the open air or dusted with ashes, sulfate, super-phosphate and other powders because these methods increase the possibility of infection and reduce the yield. After cutting every tuber the knife should be inserted in a 3 percent. solution of lysol.

In the field all diseased plants should be removed together with their tubers in order to prevent further infection in harvesting. Diseased plants have to be segregated two or three times, beginning with the end of the blooming period to the end of the vegetative period. Diseased foliage and tubers should be entirely removed from the field.

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Varieties non-resistant to ring rot should be gathered in dry weather when their foliage is dry and the skin of tubers has had a chance to toughen. The dug tubers should be dried. This should be done at once for several hours after gathering, or in well-ventilated barns and under cover for several days. If necessary, potatoes while drying may be covered, but not with potato foliage.

Among the severely infected varieties are Early Rose, Epicure, Cobbler, Deodara, Sovietski; the varieties Wohltmann, Lorkh, and the seedling of the Ulianovsk Experimental Station 160-14 are practically resistant to ring rot. Considering that ring rot is highly infectious, the container under the diseased potatoes should be disinfected by a three percent. solution of lysol or a one percent. solution of copper sulfate. Storage temperatures and humidity should not be too high; normal conditions should be maintained at all times in storage.

BLACKLEG (BACTERIUM PHYTOPHTHORUM APPEL)

Blackleg is a widely known disease. In the USSR it occurs principally in the central and northern sections of the country. In the fields it usually is found in small numbers, from one to three percent. At the same time, however, instances are well-known of an extremely severe affliction of potatoes by blackleg. In 1928 in the Nikolski-Ussuriiski region potatoes were infected 100 percent. by the disease. In 1934 the disease reached 50 to 70 percent. in the Moscow and Ivanovsk oblasts.

In severe cases blackleg causes extreme damage. Diseased plants

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either do not produce any yield at all or produce few small tubers. The disease appears in the field at the time of germination and lasts until the end of the vegetative period. Tubers affected by blackleg rapidly decay; this represents the most destructive form of tuber rot.

The appearance of diseased plants in the field is most characteristic. The diseased stems turn yellow, margins of leaves roll upwards forming a trough. Roots and base of the stem decay, blacken and soften; the diseased stems are easily pulled out of the soil. The decay may develop on tubers wherever there are injuries; occasionally the core of tubers decays. Usually decay is accompanied by the exudation of an offensive odor. The decayed tissue of the tuber is white, brown or even black.

The disease is caused by Bacterium phytophthorum. Bacteria grow best in pure culture at 28-30°C. It is capable of penetrating into a plant or tuber only through injured skin or lenticels. Experience has shown that the blackleg inducer is capable of remaining on vegetative residue in the soil until the following season. Observations under natural conditions showed a much stronger development of disease on plants cultivated uninterruptedly, and when potatoes were in heavy, moist soils.

Slicing sowing potatoes contributes considerably to the disease, especially when they are poorly stored.

Infestation takes place chiefly from infected sowing potato tubers.

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O. D. Belova states that blackleg frequently accompanies ring rot. Ring rot bacteria penetrate the tuber first and blackleg bacteria follow. The latter develop faster and suppress the development of ring rot. Blackleg develops also on tubers infested by phytophthora and damaged by frost.

In controlling blackleg, care should be taken to prevent tubers from injuries. The control of phytophthora is therefore essential, along with the control of ring rot and prevention of the freezing of tubers. In households severely affected by blackleg, sowing material should not be cut. All planting should be made with healthy selected (certified) tubers under proper crop rotation. In the course of the summer it is necessary to clean the fields of diseased plants two or three times. The first cleaning is made soon after germination, the second during the blooming of potatoes. Drying of potatoes during harvesting, timely preparation of storage quarters, and proper storing conditions are other essential measures in controlling the disease.

WET ROT OF TUBERS

The name wet rot is a collective one. It signifies any kind of tuber rot that is accompanied by the exudation of a liquid or slime. The tubers usually have a jelly-like consistency or represent a slimy mass of offensive odor. The tissue of the tuber gets brown, dirty grey or dark.

Wet rot develops on tubers injured by phytophthora, ring rot, blackleg, and low or high temperatures. At high temperatures and

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humidity decay develops rapidly. This is the most destructive form of rot which under favorable conditions may result in the entire loss of a potato yield in the course of several days.

The composition of bacteria causing wet rot is varied; the majority are saprophytes which live only on injured tubers. It is not possible to look for some regularity in the development of the disease. It develops wherever there are favorable conditions: high temperature and moisture and the presence of tubers susceptible to swift decay under the influence of saprophyte organisms. Among such tubers are those that are overcooled, overheated or in some manner injured.

Wet rot does not endanger healthy, uninjured tubers stored in proper conditions. To prevent the disease from spreading it is necessary to control such diseases as phytophthora, ring rot, blackleg, and to protect potatoes from injuries during harvesting, transit, loading. A proper storage system which does not permit over-heating or over-cooling of tubers or the accumulation of moisture in potatoes is of primary importance.

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CHAPTER III - NON-PARASITIC DISEASES

DEGENERATION OF SEED POTATO AS A RESULT OF HIGH TEMPERATURE

(Wrinkled Mosaic, Mottling, Striped Mosaic)

As is known, the original birthplace of the potato was in the high mountainous tropics of South America, where the climate is distinguished by unusually cool summers. Moderate temperatures in the hottest summer in these tropics are lower than moderate July temperatures in the central European part of the Soviet Union. Although the nature of potatoes changes in the process of cultivation, its requirement of cool summers for successful growth is clearly apparent in present-day cultivated potato plants. It suffices to point to the following fact: tuber formation ceases at 29°C.

Growth and development of potatoes in the southern USSR, as well as during dry and hot summers of the central belt, is accompanied by negative changes in the nature of the plant whenever the temperature is higher than the necessary optimum. These changes gradually strengthen in the progeny and result not only in a reduction in yield, but in the course of time alter the morphology of plants. The negative changes in the nature of the potato, incurred chiefly as a result of the growth and development of tubers under high soil temperatures (25-30°C) are transmitted through the seed material and are called "degeneration of potatoes."

Degeneration of potato tubers may occur not only during growth in the field, but also during storing in warm quarters, especially when immature

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potato tubers are exposed to this type of storage. Degeneration of potatoes may occur therefore equally in northern oblasts if tubers are improperly stored. Individual varieties of potatoes differ radically from each other; degeneration develops consequently in different ways as a result of high temperatures. Thus during degeneration resulting from high temperatures, wrinkled mosaic usually develops in early maturing varieties, while medium and late varieties produce striped mosaic.

The third form of degeneration -- mottling -- is widely spread. This form of degeneration develops as a transitory step between a normal plant and wrinkled mosaic, or as a result of the "sanitation" of wrinkled mosaic when the latter form is cultivated throughout several generations under cool growth conditions. All these forms of degeneration (wrinkled mosaic, mottling and striped mosaic) were known long ago but were considered, and many continue to consider them still, as belonging to infectious virus diseases. Experiments conducted at the Institute of Potato Industry did not confirm the infectiousness of these diseases. The juice (?) of the degenerated potato may not infect normal potato plants.

WRINKLED MOSAIC. Wrinkled mosaic develops principally on early potato varieties which have a shorter vegetative period and of which the tuber formation corresponds to the hottest summer period. In view of the above peculiarity the early varieties are less resistant to degeneration. Wrinkled mosaic is widely distributed in the south. Following drought and hot years, and in the central belt of the Soviet Union, it

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is difficult to find plantings of early varieties free from wrinkled mosaic. Wrinkled mosaic causes an average reduction of 50 percent. in yield, and at a greater degree of degeneration the reduction reaches 75 percent. and higher. Wrinkled mosaic limits the distribution of early varieties in many localities. The disease consists in the leaves of potatoes becoming wrinkled, tender, the tissue between the veins rolling upwards, while the margins of leaves roll downwards (See illustration No. 34, p. 143.) The entire plant is stunted in growth, stops blooming or produces insufficient bloom. The plants affected by wrinkled mosaic produce tubers much earlier and die earlier than normal ones. Tubers of mosaic plants may not be distinguished from normal ones. Varieties having colored tubers show a distinct loss in color when affected by the disease.

STRIPED MOSAIC develops chiefly on medium- and late-maturing varieties. These varieties form tubers mostly in the fall during a cooler period of the year. Medium and late varieties are therefore more resistant to degeneration than are the early varieties. Striped mosaic is, consequently, less spread than is wrinkled mosaic. The former is accompanied by tenderness of leaves and stems, although in the first year there is no wrinkling of leaves. Striped mosaic is characterized by the dying of tissues of veins of leaves in the form of stripes, as well as the dying of leaf tissue in edges between veins (see illustration No. 35, p. 145). Foliage dies prematurely; yield is considerably reduced; tubers do not carry any evidence of the disease, but when sowed produce in the following year plants that have wrinkled leaves and are greatly depressed; there is practically no harvest of tubers.

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MOTTLING is the most prevalent form of degeneration resulting from high temperatures. As indicated, the disease develops in two ways; it is either a transitory step from normal plants to wrinkled mosaic or from wrinkled mosaic to mottling, whenever mosaic plants are cultivated from year to year in cool and moist conditions.

The loss in yield from mottling reaches 15 percent. If its wide spread is taken into consideration, one will appreciate the negative effect of the disease. Mottling shows in lighter colored potato leaves, with diffused spots. These become more noticeable if one places a piece of white paper under a leaf. Mottling is usually observed before blooming; during other periods diseased plants may not be told apart from healthy ones.

METHODS OF CONTROLLING DEGENERATION RESULTING FROM HIGH TEMPERATURE. Potatoes in localities of hot summers should be sowed in the summer. Particular attention should be directed to storage conditions for seed material, to prevent growth of potatoes for as long as possible. The ditch method for storing potatoes by covering them with earth is the most satisfactory for the purpose.

Whenever there are few degenerated plants, the seed plots of spring as well as summer plantings should be cleaned of degenerated clumps. If there are more than 30 percent. of degenerated potatoes, it is advisable to engage in plant selection, marking the healthy plants with thread or sticks, etc., and segregating them for seed purposes. Such improved selection may be accomplished by a simple method.

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It is always possible to find a time in harvesting when the foliage of degenerated plants is already dry and that of normal plants has remained green. In such manner it is possible to segregate for seed purposes the non-degenerated green foliage plants. In the central belt of the USSR spring planting, aside from summer planting, may be recommended for early varieties. Seed plots should, however, in those cases be laid in cultivated soils in river valleys (bottom land), on properly dried-out peat bogs, and preferably on soils of the garden type where the moisture of soils is higher and summer temperatures are lower than usual. To protect the soil on small plots of elite sowings from over-heating, mulching with straw is recommended following the germination of potato seeds. On seed plots potatoes should be planted more densely (50 to 55 thousand plants per hectare.) Foliage offers better shade to the soil when thickly planted, protecting it from unnecessary over-heating.

Whenever the number of degenerated plants is large (about 50 per cent), rows of seed plots should be planted twice as thickly. When germination is over, all degenerated plants should be eliminated. Such early cleaning radically reduces labor expenditure.

Lack of control of degeneration of seed potatoes in southern and central zones of the Soviet Union will interfere with high yields of early potato varieties.

SPINDLE TUBER ("GOTHIC")

Conditions causing various forms of spindle tuber are not known. Observations have established that spindle tuber develops faster in an improper, unbalanced nutrition of plants.

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The disease produces stunted growth in plants; leaves are characterized by slenderness and uprightness ("gothic") and cling closer to stems than normal plants. The tips of young leaves are usually rolled. The described traits are not fully present on leaves of all varieties and a safer recognition is therefore found in the external appearance of tubers. The latter have a tendency to be longer, the number of eyes is larger (see illustrations Nos. 36 and 37, p. 147).

The coloring of plants affected by spindle tuber is less bright than that of normal plants; potato yield is reduced by one-half. The varieties Majestic, Early Rose and Lorkh are most frequently affected by spindle tuber.

In order to control the disease, tubers of oval-roundish shape should be selected for planting and all elongated tubers with a large number of eyes rejected. Whenever the characteristics of spindle tubers are well demonstrated on the foliage, a cleaning of all gothic plants on the seed plot is in order.

LEAF CURL OF POTATO

Leaf curl is one of the widespread forms of degeneration, of which the causes leading to its development are not known. The number of affected plants amounts in some households to 100 percent. Observations conducted on many different varieties of potatoes indicate that the disease reduces the yield 13 to 53 percent. Externally leaf curl differs radically from normal plants. It has a great many thin stems; its leaves are simpler than those of normal plants; the end lobe of the leaf is gradually enlarged (see illustration No. 38, p. 148).

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Leaf curl produces many small tubers and no large ones. If large tubers are planted the disease disappears from the plots. Cleaning of seed plots is also an effective measure for controlling leaf curl.

NEGATIVE CHANGES IN SEED MATERIAL RESULTING FROM DEFECTIVE NUTRITION (Brown spot, stem blackening, iron spot of tubers, and bronze leaf).

The reduction in the yield of seed potatoes, as well as the appearance of pathological characteristics are caused not only by high temperatures but also by the improper nutrition of potato plants, this being particularly damaging when the deficiencies are continuous from year to year.

Plants possess a selective capacity in their rooting system; but under field cultivation the available plant food frequently varies radically from plant requirements, and the plants, in spite of their selective ability, act in a manner different from that of previous generations. During vegetative propagation this circumstance reduces the yield of the seed material. At times the deficiencies of nutrition are so strongly marked that not only the yield of the seed material is affected but well pronounced pathological characteristics are observed.

Let us consider some of the most prevalent diseases caused by improper nutrition.

BROWN SPOT (MOTTLING) OF STEMS (see illustration No. 59, p. 149). In the beginning of the vegetative period the plant has a lighter-colored foliage (first stage of disease); during the second part of July or in early August brown, elongated spots of dead cork tissue appear on the stems. These spots increase in size, the leaves gradually die, first the lower

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then the upper ones; when dry, they remain hanging on the stems (second stage of disease.) Yield is reduced because of the premature dying of leaves. Tubers of diseased plants do not show disease characteristics but the plants that are produced by them are of low yield and much more easily affected by spotting than plants obtained from tubers of healthy plants.

The second disease traced to improper nutrition, FERROUS MOTTLING (SPOTTINESS) OF TUBERS, produces areas of brown-colored tissue of different shades within the tuber. These spots are seen in slicing; they are of hard consistency and never decay. The disease does not produce any symptoms on the leafage, but it reduces the yield and the percentage of starch content in tubers, and spoils the quality of the seed.

Improper nutrition is the result of the washing of soil by heavy rain which deprives the soil of nitrogen, calcium and magnesium, and increases the solubility of the ferrous element.

During abundant spring rainfall, when improper nutrition begins early, it produces spottiness of stems; if improper nutrition takes place during the period of tuber growth, the result is ferrous spottiness. The latter is aided by a high soil temperature, during the period of tuber growth.

The occurrence of the above diseases in zones of podzol soils points to the necessity for their radical improvement.

The following measures should be undertaken to control these diseases:

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Increase of the complex of light soils by the introduction of organic fertilizers, marl or young (?) limestone. The addition of mineral fertilizers to manure on light soils to fertilize varieties non-resistant to spottiness, such as Lorkh, etc.; potassium is best introduced in the form of wood ashes or in the form of potassium salts of high percentage. In using low percentage (raw) potassium salts, potassium bisulfate should be added (about 30 kg. per hectare.)

Potato plants, severely attacked by stem spot, should be removed from seed plots and under no circumstances be used for seed purposes.

BRONZE LEAF of potatoes is caused by lack of potassium on peaty and virgin soils. Leaves of diseased plants are wrinkled, part of the tissue between veins gets gradually brown, and as the disease progresses the leaves take on a bronze coloring and die prematurely. At the first signs of disease the potatoes should be given a supply of manure liquid or a solution of potassium salt. Local fertilizers rich in potassium (manure and ashes) or other mineral fertilizers should be introduced on affected plots.

In order to prevent yield reduction of seed material because of improper nutrition, it is essential to plant potatoes on plots having soils of high natural fertility. Seed plots should be fertilized first of all with local fertilizers containing all nutritional elements. In using unbalanced mineral fertilizers, it is necessary to consider the requirements of plants in nutritional elements for the given plot. An abundance of some of the nutritional elements, as well as the lack of some, reduces the yield in seed material.

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OVER-GROWTH OF TUBERS AND THE FORMATION OF "BABIES"

Young tubers occasionally form stolons during growth on which new small tubers (tubercles) germinate. This condition is called OVER-GROWTH of tubers. It occurs as a result of interruptions or weakening of the photosynthesis in hot and dry weather. The capacity of young tubers to grow during interruptions in the photosynthesis does not last long (about ten days.) In that time the young tubers have a chance to mature in such degree that their tissues lose the capacity for future growth. When rain falls, however, and the hot period changes to cool days and photosynthesis is resumed, the latter's products derived from the foliage for the benefit of tubers may no longer suffice for the growth of previously formed tubers. Stolons are produced from eyes of tubers incapable of normal development; the new tubers germinate from the stolons. The interruption (weakening) of photosynthesis under hot summer conditions occurs sometimes repeatedly... The result is the formation of tubercles (small tubers) of the first, second, etc. order, appearing in the shape of a chain.

If during the interruption of photosynthesis all tissues of the young tuber have not had time to mature and have, moreover, lost their capacity for development, the least mature among them, (i.e., the upper ones and those closest to the eyes) continue their growth with the resumption of photosynthesis; the result is deformed growth on tubers, referred to in our literature as "babies". During an abundant supply of products of photosynthesis, following a resumption of the growth of the tip of the tuber, tubers are formed in the shape of the figure eight.

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When planted in the summer, tubers have the opportunity to develop in cooler weather; there is therefore no interruption in photosynthesis; consequently, over-growth and formation of "babies" are also lacking.

FORMATION OF TUBERCLES ON SEED POTATO TUBERS

During the spring small tubers form at times in storage bins, as well as in the soil, in place of sprouts. The formation of these small tubers on mother tubers usually occurs because of the absence of conditions which encourage the growth of sprouts at a time when the tubers are filled with soluble nutritious elements.

It is known that a lower temperature is required for the formation of tubers than for the development of stems and sprouts. At a temperature lower than plus 5°C, (if the tuber is full of soluble elements), sprouts will not grow but tubers may still form. Consequently, in planting tubers filled with nutritious elements in cold weather (2-5°C), the result is the formation of small tubers and not sprouts. Another circumstance has to be further taken into consideration. It is known that tubers breathe much less intensely than do sprouts. More air is required for the growth of sprouts than for the growth of tubers. Sometimes there is so little air in the soil that sprouts are unable to grow, while there is enough to contribute to the formation of small tubers.

As a result, small tubers are able to form in the soil, as well as in storage, whenever air is lacking and the temperature is high. Potatoes most inclined to form small tubers are those which suffered many bruises in harvesting and transit in the fall. The breathing process of these

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tubers is more intense, with the result that starch is transformed more rapidly into sugar.

Normal conditions of potato storage and timely planting in warm weather prevent the appearance of this disease.

BLACK ROT CAUSED BY STRANGULATION OF TUBERS

When high temperature and poor ventilation prevail in storage the internal tissues of tubers die from strangulation. The dead tissues turn black. Gradually the external tissues die also. Good ventilation and piling not higher than 0.5 m. are essentials in storing potato tubers.

DARKENING OF TUBER PULP

Careless treatment of tubers during harvesting and transit produces in a few days dark spots with light outlines of different size on cut tubers. Occasionally the darkening of the tuber is distributed along the ring of vascular knots and is erroneously referred to as ring rot. We wish to stress that the ability of tubers to react in this manner to bruises is not frequent. It depends upon the particular variety, fertilizers and the weather prevailing during potato growth.

Darkening of the flesh results from the production of acids of dark coloring by tyrosine (one of the amino-acids of the tubers.) The acidification of tyrosine occurs in the presence of large quantities of reduced (?) sugars (glucose and fructose.) The amount of sugar in tubers is large when the latter are harvested in an immature condition or when potassium was lacking in nutrition, resulting in the delay of the polymerization of starch from sugar and the accumulation of sugars in the tubers.

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In addition, acidification in tubers is accelerated by bruises received in harvesting and transit. The pulp therefore, as a rule, darkens following harvesting and transportation of tubers.

Darkening of tuber flesh spoils the taste qualities of potatoes, and when severe, reduces their seed qualities. It also reduces the yield 14-22 percent. Measures of control: In cultivating varieties inclined to darken because of bruises (var. Wohltmann) it is necessary to wait until the tubers are fully mature before harvesting.

Increased doses of potassium fertilizers should be introduced in fertilizing potatoes. A particularly good reaction is obtained from wood ashes and high percentage potassium fertilizers. Raw potassium salts should be avoided in fertilizing potato plants. Extreme care should be exercised in handling potatoes in gathering, transit, hauling, and storage.

TUBER INJURIES CAUSED BY FROST

Frost injury occurs in the field prior to harvesting, as well as in storage. Severely frozen tubers become soft after thawing, the juice is easily squeezed (as a sponge squeezed of water) and their decay is rapid. Cases of light freezing are frequent. When thawed the tubers preserve their healthy appearance but one soon notices brown spots on cuts which usually extend from the skin and frequently are taken for infestation by phytophthora. Such tubers lose their taste qualities and are unsuited as seed material. Frozen tubers that were never thawed may be used for food, if in cooking they are immediately plunged in boiling water.

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CHAPTER IV - POTATO PESTS

COLORADO BEETLE (Leptinotarsa decemlineata Say)

The Colorado beetle or potato leaf-eater is at present widespread in America and Western Europe. In spite of the most energetic measures to eliminate the pest, it firmly established itself in France, penetrated next into Germany, Belgium, Luxemburg, Switzerland, and the Netherlands. In the USSR there are no Colorado beetles at present but there is danger of their introduction.

The rapidity of the spread of this leaf-eater is explained by the fact that it moves with ease from place to place. It spreads through flight and is also introduced by transportation facilities, i.e. steamships, trains, aeroplanes, etc. It was carried into Western Europe by the latter means from America.

The beetle and its larvae feed on leaves of potato plants. Potatoes and eggplants represent its principal food. The progeny of one beetle consumes per year three hectares of potatoes.

Externally the potato leaf-eater is very characteristic. Of oval shape and relatively small size; its upper wings of pale yellow to clay-yellow coloring have ten black, elongated stripes. The wings are a bright pink-red. Dispersed on the frontal part of its back are 11 black spots, of which the central one, the largest, frequently resembles the Roman figure V. The larva has a thick belly; reaches 15 mm. in length when mature. When young, it has a reddish color, turning to orange-yellow. The head, breast

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shield (cover), and a double row of warts on each side of the body are black. It pupates in the soil, where the beetle also winters.

The Colorado beetle is capable of rapid propagation, producing one to three generations a year, although two generations are more typical. Where it produces two generations conditions are most favorable. While the beetle withstands radical changes in temperature, it develops best at 17-20°C. Regions of distribution correspond therefore with regions of potato production. As to the altitude of the locality, it prefers settling no higher than 1700 to 1800 m. above sea level. 2000 m. represents an unsurmountable limitation (height.)

Control consists in spraying potatoes with poisons of intestinal action. In eliminating the first loci (of infection) the beetles and their larvae are picked from plants and soil, the soil is treated with mordants and the plants are destroyed. Simultaneously, adjoining potato plants are sprayed several times with poisons of intestinal action.

In recent years work has been undertaken to produce varieties resistant to potato leaf-eater. The following varieties are at present recommended for selection: Solanum demissum, Sol. polyadenium, S. henrii, S. Jamesii, on all of which the insects perish in the larvae stage. Experiments are being continued on Sol. acaule, S. commersonii, S. verrucosum, S. chacoense, on which the insects in the majority of cases perish while they pupate. Among cultivated varieties the canker-resistant varieties Al', Weltwunder, Framm, and the non-canker-resistant variety Wohltmann possess relative resistance.

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TWENTY-EIGHT POINT LADYBIRD - EPILACHNA VIGINTIO PUNCTATA F.

This insect is spread in Korea, China, Manchuria, Japan, on the islands of Java, Ceylon, in New South Wales (Australia). In the USSR it is found in the Far East, the Ussuri oblast, the Primorsky and Khabarovsk territories.

Ladybirds injure potatoes, soya beans, eggplants, tomatoes. They feed on the soft parts of leaves, avoiding the veins. Infested fields have a naked appearance, since in place of leaves only skeletons of veins remain. The principal damage is caused by larvae whose harmful activity is interrupted by frost.

The beetle is brown red, of protruding shape; 28 black spots are distributed on both wings. The insects produce three generations a year. Egg-laying begins the end of May and eggs are laid in groups of 15 to 20 on the underside of leaves. Ten days later larvae appear; they turn into pupae on leaves or stems and in another week the mature beetles make their appearance. The beetles winter in the soil, under leaves, beginning September.

This pest is spread in all stages of development by seed material.

METHODS OF CONTROLLING LADYBIRDS. Fumigation of infested potatoes, spraying with Paris green, dusting with fluosilicic sodium or calcium arsenate.

WIRE WORMS - ELATERIDAE

Wire worms, otherwise named "kostianik", are the larvae of the "click beetle." The larvae are hard to the touch and are colored yellow, less

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frequently brown. Plants are injured by larvae. These gnaw at potato stems and enter the tubers, leaving their excrements there. If present in large quantities (80-120 pieces to 1 m^2) the larvae destroy oats and potatoes 100 percent.

The condition of the upper horizon of the soil influences the number of wire worms. Their number on soft, old plowed lands is reduced to a negligible degree; but, as soon as the soil is left waste, their number rapidly increases. Wire worms are present in much larger numbers on plots of heavy, moist soils, that are rich in humus, than on plots of light, sandy or sub-sandy soils. The pests create their greatest damage in the first three to four years after the cultivation of the layer (stratum).

Among all recommended measures for the control of wire worms, principal attention should be directed to agricultural techniques: the careful cultivation of the soil, weed control, black fallows, deep plowing.

STEM BORER - PHYTOMETRA GAMMA L. (LEPIDOPTERA)

"Sovka gamma." Its mass spread was noted in 1912, 1922 and 1928. Injury is caused by the caterpillar which gnaws on leaves. Potatoes are injured in years of widespread propagation of the pest. the variety Lorkh suffering particularly from attacks.

Phytometra gamma L. is a butterfly of which the front wings are deep-brown with a silver mark resembling the Greek letter gamma. The caterpillar

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has 12 legs; its color is green or green-yellow with indistinct yellowish stripes on the back and a pale elongated stripe on the sides. The body has clearly noticeable hairs. The formation of a chrysalis (pupating) occurs on the plant or on the surface of the soil, among clumps of earth and vegetative residue. The cocoon is silky, loose, transparent. Methods of control: destruction of weeds, the utilization of caterpillar nets, spraying or dusting of plants with poisons of intestinal action.

Phytometra (gnawing) ("podgryzaushchie"); caterpillars gnaw the young potato sprouts, occasionally penetrate into stems and eat up their core. In tubers they gnaw holes, of smooth regular margins which are frequently covered with the remains of the uneaten skin. In digging tubers in holes one may frequently discover caterpillars under the remaining skin.

The control of these pests is very difficult because they gnaw at plants early in the morning and disappear in the soil for the rest of the day. The planting of catch crops is recommended, the introduction into the soil of treated attractants, control of weeds and early plowing of fields.

SCARABIADAE (FAMILY PHYLLOPAGA (GENUS)

Scarabiadae is the larvae of the May beetle. Larvae injure tubers, gnawing holes of roundish form of irregular borders. In contrast to Lepidoptera, their holes are open and have no residue of skin.

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Methods of control recommended at present are not effective. More effective are the gathering of larvae, following plowing, gathering of beetles during the period of additional nutrition, the dusting of plants with fluorine combinations during additional feeding, the protection of birds eating these insects; the treatment of soil with mordants.

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Translated in part by S. N. Monson

Appendix 2: List of Scientific Institutions to which is assigned the Growing of Elite Potatoes, p. 178-179.

Names of Institutes Selection and Experiment Stations:	Republics, Territories and Oblasts:
1. Azerbaidzhan Scientific-Research Institute of Grain Industry	Azerbaidzhan SSR
2. White-Russian Government Selection Station	White Russian SSR ("Belorusskaia")
3. All-Union Scientific-Research Institute of Genetics and Selection	Odessa Oblast
4. Georgian Selection Station	Georgia SSR
5. Kirgiz Vegetable Experiment Station	Kirgiz SSR
6. Leninakan Selection Station	Armenian SSR
7. Uzbek Vegetable Experiment Station	Uzbek SSR
8. Ural Experiment Station	Kazakh SSR
9. Turkmen, Vegetable Experiment Station	Turkmen SSR
10. Kharkov Agricultural Institute	Kharkov Oblast
11. Aleksandrovsk Selection Station	Vladimir Oblast
12. Bashkir Agricultural Experiment Station	Bashkir ASSR
13. Valuisk Agricultural Experiment Station	Stalingrad Oblast
14. Voronezh Agricultural Institute	Voronezh Oblast
15. Voronezh Potato Experiment Station	Orlov Oblast
16. Gorki Agricultural Experiment Station	Gorki Oblast
17. Gorski Selection Station	North-Ossetin ASSR

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18.	Far-Eastern Vegetable Experiment Station	Khabarovsk Territory
19.	West-Siberian Vegetable Experiment Station	Altai Territory
20.	Ivanov Oblast Experiment Station	Ivanov Oblast
21.	Kazan Agricultural Institute	Tartar ASSR
22.	Kalinin Oblast Experiment Station	Kalinin Oblast
23.	Kamalinsk Experiment Station	Krasnoyar Territory
24.	Kirov Government Selection Station (Falenki)	Kirov Oblast
25.	Krasnodar Vegetable Experiment Station	Krasnodar Territory
26.	Crimean Vegetable Experiment Station	Crimea
27.	Kurkin Selection Station	Vologod Oblast
28.	Leningrad Potato Experiment Station	Leningrad Oblast
29.	Minusinsk Experiment Station	Krasnoyar Territory
30.	Scientific-Research Institute of Potato Industry	Moscow Oblast
31.	Scientific-Research Institute of Grain Industry of the South East	Saratov Oblast
32.	Novozybkov Agricultural Experiment Station	Briansk Oblast
33.	Novo-Siberian Selection Station	Novo-Siberian Oblast
34.	Novo-Siberian Agricultural Institute	Novo-Siberian Oblast
35.	Petrovsk Selection Station	Penza Oblast
36.	Sverdlovsk Agricultural Experiment Station	Sverdlovsk Oblast
37.	Siberian Scientific-Research Institute of Grain Industry	Omsk Oblast
38.	Tulun Selection Station	Irkutsk Oblast

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39.	Ulianovsk Potato Experiment Station	Ulianovsk Oblast
40.	Cheliabinsk Vegetable Experiment Station	Cheliabinsk Oblast
41.	Chkalov Oblast Experiment Station	Chkalov Oblast
42.	Yaroslav Agricultural Institute	Yaroslav Oblast
43.	Yartsev Experiment Field	Krasnoyar Territory

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75 B86K

Translated from the Russian by
S. N. Monson

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Declassified and Approved For Release 2013/03/25 : CIA-RDP80R01426R009900010001-5

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75 B86K

Translated in part by
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TASKS OF POTATO GROWING (p. 3-5)

Potatoes represent the most important food and technical culture (crop). The law concerning the reconstruction and development of agriculture for the years 1946 to 1950, and the decrees of the February Plenum of the CC of the VKP(b) of 1947 devote considerable attention to the reconstruction and further rise of potato growth in our country.

For agriculture in the Leningrad oblast potatoes, along with other vegetables, present a leading crop. The main task of potato growing in the oblast is to obtain gross harvests of potatoes that would fully meet the demands of the population of Leningrad, inhabitants of the largest industrial and cultural center of our country. This task should be solved in the course of the next few years by widening sowing areas and especially increasing the yield of potatoes. By 1950 the demand for vegetables and potatoes at Leningrad should be satisfied to the amount of 65 - 70 per cent through the production of this valuable food item within the oblast.

In order to stimulate collective farmers, workers of MTS, state farms and additional households to strive for high potato yields, the Presidium of the Supreme Soviet of the USSR in its Decree of September 17, 1947, ordained high awards for advanced workers in potato growing, i.e., the designation of Hero of Socialist Labor and the awarding of medals of the USSR.

(Omitted 36 lines)

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The Leningrad oblast is situated in the zone where compulsory production of canker-resistant potato varieties has been fixed. By 1950 the oblast is obliged to sow exclusively canker-resistant varieties of potatoes. The variety Berlichingen which is canker-resistant and has consequently forced out (dislodged) other varieties, possesses, nevertheless, considerable shortcomings, the most important one of which is its susceptibility to virus diseases. As a result, along with the search for healthy clones of Berlichingen and the planting of its superelite seed, new canker-resistant varieties, primarily of the early kind, are to be introduced. At present a group of varieties of domestic and foreign production are being tested and introduced into production. Leningrad oblast possesses at the same time a sufficiently prominent station (base) for a potato of its own selection which stands for the most radical means of controlling not only potato canker but the combatting of virus and phytophthora diseases. This can be achieved by producing new varieties of potatoes, resistant to both canker and phytophthora. The fact that the All-Union Institute of Plant Industry (the central point for potato selection) is located at Leningrad will ensure the solving of this task in a short space of time.

Of primary importance in potato growing will be the production of early potatoes, to be aided by the introduction at state and collective farms of the oblast of early canker-resistant varieties and the consideration given specific agricultural methods required by early potatoes.

It seems appropriate to refer here to the large role played by early potatoes in individual gardening, so widely developed among the working masses of Leningrad and its oblast. Under conditions of individual

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gardening such important agricultural methods in the culture of early potatoes as vernalization of tubers and the preparation of potato seedlings ("rassada") are available to the individual gardener. Equally available is also the most profitable method of harvesting early potatoes, the gradual "under-digging" ("vyborochnii") as commercial tubers mature.

One should also remember the "minor" points, which at times appear of little significance in aiming at high potato yields and their prolonged storing without losses. It is known, for instance, that potatoes are best stored in ordinary wooden boxes. In spite of it, this method for storing potatoes is not widely practiced. Vernalization of potatoes in boxes is also of advantage, since in that case the germinated seed potatoes do not have to be transferred but may be transported directly to the fields for sowing.

Or let us take such a "minor" point as the installation in the field of temporary ordinary sheds for the drying of potatoes after harvesting, a measure that is of major importance in gathering in damp weather. All these and other minor points will save thousands and tens of thousands of tons of potatoes from losses which occur yearly and regularly with us. In raising the level of our potato growing we cannot afford to overlook these minor considerations. The simplest measures, improved as a result of rational practices, should be accorded necessary attention along with the latest achievements in agricultural science and technique.

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End of Chapter

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Declassified and Approved For Release 2013/03/25 : CIA-RDP80R01426R009900010001-5

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75 B86K

Translated in part by
S. M. Monson

CHAPTER IV - POTATO VARIETIES IN THE LENINGRAD OBLAST (p. 91-105)

Regionalization of Varieties

Regionalized potato varieties are divided into principal, potential, admissable, and temporarily admissable varieties.

The principal varieties are of greatest economic value; they have been adequately studied and widely distributed.

Potential varieties are those which while distributed are of less economic value and are intended to be eventually replaced by the principal varieties.

The admissable varieties, while also distributed, have fewer economically valuable qualities than the principal varieties and will be replaced by the latter in the future.

The temporarily admissable varieties are those accepted temporarily, pending such time that principal varieties are substituted for them. The Government decreed that by 1950 the entire Leningrad oblast should transfer to plantings of canker-resistant potato varieties exclusively. The following potato varieties were regionalized at the Leningrad oblast:

PRINCIPAL VARIETIES: Great Scot, Majestic, Berlichingen.

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POTENTIAL VARIETIES: Cobbler, Kalev, Aberdeen-Favorite, Paul Wagner.

ADMISSABLE VARIETIES: Jubel, Phytophthora-Resistant.

TEMPORARILY ADMISSIABLE VARIETIES: Epicure, Early Rose, Narodny.

In the past three years the list of temporarily admissable varieties has been considerably increased at the expense of accidentally brought in potatoes. Thus were introduced the varieties Wohltmann, Hero, Gracia, Krüger, Silesia, Lorkh, Korenevsky, Smyslovsky, etc. These latter varieties are noncanker-resistant and will therefore have to be replaced by canker-resistant varieties.

KEY FOR DETERMINATION IN THE FIELD OF POTATO VARIETIES; REGIONALIZED AND DISTRIBUTED IN PLANTINGS

I. Flowers white

A. Bloom profuse

1. Anthers orange

a) ovary colored inside; tubers pink (light red) .....Early Rose

b) ovary not colored inside; tubers white; leaf large-lobed, calyx pigmented...Majestic

c) leaf large lobed; calyx clear green'Smyslovsky

d) leaf small-lobed; calyx pigmented...Paul Wagner

2. Anthers yellow or greenish-yellow, undeveloped; leaf strongly serrated;

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tubers white, flesh-colored tint.....Epicure

B. Bloom deficient, buds undeveloped, frequently fall off; anthers greenish-yellow, undeveloped; leaf strongly serrated, tubers white; round-oval.....Great Scot

II. Flowers colored; joints of peduncles colored; leaf large lobed

A. Flowers red-violet; tubers red;

1. Anthers frequently deformed; buds open early; base of calyx and peduncle brown..Berlichingen

2. Anthers and buds normally developed; base of calyx and upper part of peduncle green.....Centifolia

B. Flowers blue-violet; tubers blue; anthers green-yellow.....Phytophthora-Resistant

III. Flowers colored; joint of peduncle not pigmented

A. Flowers red-violet; tubers red; stem brown....

1. Leaf narrow-lobed, attached at sharp angle.....Wohltmann

2. Occasionally ivy-leafed, lobes wider....Hero

B. Flowers red-violet; tubers white

1. Leaf large-lobed
* bloom short

a) inflorescence compact; leaf dark green, tough; medium serrated; tubers round oval.....Cobbler

b) inflorescence half-spread; leaf slightly serrated, tubers round, parsnip-shaped.....Kalev

** bloom long

a) flowers brightly colored; sharp ends of calyx lanceolate, peduncle above junction pigmented.....Korenevski

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b) flowers pale with white sharp tips on both sides; sharp tips of calyx resemble leaves; peduncle green.....Lorkh

2. Leaf small-lobed

a) flowers with white sharp tips.....Jubel

b) flowers completely colored.....Parnassia

B. Flowers blue-violet; tubers white; leaf large-lobed; anthers green-yellow.....Narodny

DESCRIPTION OF VARIETIES OF POTATOES

BERLICHINGEN. Plant tall, well leafed; stem green, colored in leaf axils. Leaf lightly serrated, first dark green, later light green, dull, with relatively pronounced veining; lobes round, wide, pointed at tip; margins of first lobes imbricate; axils of stems and petioles are colored by anthocyanin. Bloom profuse, double layered; buds open early; inflorescence spread, usually consists of 3-4 curls, frequently with upper leaflets; peduncle brown-green; with dark red junction; upper part of peduncle short, junction frequently reaches to base of calyx; calyx green with colored base, (in constrast to Centifolia variety). Corolla bright red-violet with completely white sharp tips below and above; frequently double-flowered; anthers light orange, often deformed; stem not thick, rises above anthers column, stigma green, club-shaped (clavate); fruit-formation from natural pollination infrequent; tubers red coloring is in skin; oval, flat, with blunt tops, small eyes are more intensely colored (both in and under the

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skin); the latter peels but slightly; pulp white, darkens in cooking, especially when cooled. Sprout red-violet. Economic qualities: medium maturing high yield variety; keeping quality good at a temperature of 1 to 3°; medium starch content; germinates early at higher temperature in storage bin; non-phytophthora-resistant; fairly resistant to scab but susceptible to rust spot, cracking and ("duplistost") hollows (?); frequently suffers from speckling (spottiness) ("krapchatost"); resistant to canker.

2 KOHLTMANN VARIETY. Plant tall, lightly leafed, stem strongly colored, red-brown; leaves stand out from stem at sharp angle; slightly serrated, lobes long, narrow, (length twice that of width), stand far apart from each other; halves prominently raised above midrib. Illustrations No 21 and 22 of Berlichingen and Great Scot tubers respectively. Bloom medium, occasionally scanty; receptacle and peduncle colored; corolla pale red-violet with more intensive red margins around rays of star; sharp tips are white underneath and white spotted above; anthers yellow or light orange, irregularly colored; no natural fruit formation. Tubers red (under skin) round-oval, occasionally with sharpened tips; eyes of medium depth, lighter than the original background of tuber; pulp white or cream. Economic qualities: late, industrial variety, of high starch content; medium yield; good keeping quality; non-canker resistant.

3 GREAT SCOT VARIETY. Plant tall, stem green, slightly colored in leaf axils; leaf strongly serrated; lobes dark green, smooth, shiny,

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with small wavy margins. Bloom scanty or altogether absent; buds when undeveloped frequently fall off; flowers poorly developed; corolla white, with narrow lobes; anthers yellow or yellow-green, narrow, almost no pollen; stigma large; stem usually bent; no natural fruit formation. Illustrations No 23, 24 and 25 Great Scot, Kalev, Cobbler, respectively. p. 95. Tubers white, round or roundish-oval, slightly shallow, with blunt, frequently depressed tips (group of upper eyes is deep), and slightly depressed stolons; side eyes not deep, with long, clearly formed eye brows; pulp white, sprouts (light) have brown-red, half-opened top, brown-green, short neck and red-violet base. Economic qualities: medium maturing, table stock variety of good taste; resistant to leaf roll and mosaic; keeping quality medium; resistant to canker.

4 KALEV VARIETY. Plant half spread, medium leafed; leaf slightly serrated, dark green; lobes large, almost round with pronounced veining, shiny. Inflorescence scanty; not spread; peduncle short, green; corolla red-violet, with white sharp tips above, (in young flowers underneath), occasionally double flowered; calyx green, anther column conical; anthers orange; stigma not large, double-lobed; stem of medium thickness, not long, about the size of another column; fruit formation occasional but not abundant. Tubers yellow, round, shallow, with blunt or depressed top; pulp white, darkens in slicing. Sprouts (light) have narrow top, short, closed, red-violet; neck dark-green, shiny; base at first green, with age red-violet; anthocyanin appears; brown tubercles non-colored, not large; lenticels clearly seen; sprouts not large. Economic qualities: medium-early maturing, yieldy variety,

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on moist plots designated for forage; medium starch content; occasional splitting of tubers; keeping quality good; canker-resistant. Illustrations No 28 Majestic (p. 97).

5 COBBLER VARIETY. Plant medium tall, half-spread, well leafed; stem erect, thick, green, with spotted red-violet pigmentation; in leaf axils, especially inner part of stem, red-violet pigment; leaf dark green, large, medium serrated, tough; lobes large, wide, elliptical, imbricate, veining pronounced; base of end lobe heart-shaped. Bloom profuse, but brief; inflorescence compact, large, consists of 4 whorls, and from 6-7 flowers in each whorl; receptacle long, strong; corolla red-violet, with white sharp tips on both sides, rapidly whitening; calyx green, colored at base with lanceolate, sharp tips frequently appearing leaf-size; anthers orange, column slightly conical; stem straight, not thick, with stigma hardly rising above anther column; stigma velvet-green; no natural fruit formation. Tubers large, white, roundish and oval; medium and small eyes; pulp white, darkens in slicing; bud-eye cluster close. Sprouts (light) have red-violet base, ball-like, pubescent; neck green; top red-violet, half spread, short. Illustration Nos. 29 and 30. Early Rose and Aberdeen-Favorite. Economic qualities: Early maturing, table stock variety; good yield; low or medium starch content; suitable for early breeding; keeping quality poor; strongly affected by phytophthora and black-leg; canker-resistant.

6 KORENEVSKI VARIETY. Plant tall, well leafed; stem green, leaf slightly serrated; lobes large with regular margins, slightly extending

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along midrib, frequently green with pronounced veining. Bloom profuse, prolonged; inflorescence spread; receptacle green; upper part of peduncle colored; corolla- red-violet, intensely colored, its sharp tips white underneath and white spotted above; calyx green, slightly pigmented on veins of lobes; anthers orange; no natural fruit formation. Tubers white, oval elliptical; eyes of medium depth; skin peels frequently. Economic qualities: medium-late, table stock-industrial variety of high yield; starch content above normal; keeping quality good; non-canker-resistant.

7 COURIER VARIETY. Local designations (names): Snezhinka, Gorlovski, Shestinedelny, Rostovski, Toksovski, etc. Plant low, well leafed; stem green, with shiny drooping leaves; leaf slightly serrated; first pair of lobes extends from stem at sharp angle and is directed towards end lobe; lobes imbricate, first pair covers the end lobe; lobes smooth, shiny, light green. Bloom light; buds frequently fall off before fully developed; corolla white; anthers light yellow or green-yellow, undeveloped; no natural fruit formation. Tubers white, roundish oval, shallow (pancake-shaped) with small eyes; white pulp. Illustration Nos. 31 and 32 Epicure and Fruheboat tubers, p. 99. Economic qualities: early maturing table stock variety; tasty; strongly susceptible to phytophthora; keeping quality poor; canker-resistant; not regionalized; appears as a mixture.

C LORKH VARIETY. Resembles the Korenev variety in its outward characteristics. The distinction is in the following: corolla light red-violet, with white sharp tips above and below; stigma large, with 2 yellowish spots

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above; on stem of end lobe a wing (resembling a film); frequent ivy-leaf resemblance (the junction of end and first pair of lobes); peduncle all green. Economic qualities: medium-late table stock-industrial variety of high yield; good keeping quality; non-resistant to canker.

9 MAJESTIC VARIETY. Plant tall, upstanding, well leafed; stem green; leaf strongly serrated; lobes elongated with regular margins; first pair overlapping and lobe, extends at sharp angle and is directed towards end lobe; dark green, dull, strongly pubescent. Bloom profuse; inflorescence spread; receptacle long, thin; corolla white or cream, at lower side weak traces of violet tint, especially on bud; calyx dark green with narrow sepals and lanceolate sharp tips; anthers orange; stigma heady (?) ("golovchatoe") dark green; stem thin, extends above anther column; some natural fruit formation observed but fruits are small and easily fall off when undeveloped. Tubers white, elongated-oval, with base narrower than tip; eyes small with clearly defined eye brows; pulp white; sprouts (light) have closed, green tops; neck green, base red-violet, strongly pubescent. Economic qualities: medium-maturing table stock variety; yield and starch content medium; keeping quality good; canker resistant.

10 NARODNY VARIETY. Local designations: Imperator, Pernatka. Plant tall, upstanding; stem pigmented in leaf axils; leaf slightly serrated; lobes large, standing apart from each other, the first pair overlapping the end lobe; sharply veined. Inflorescence spread, with two or three whorls; flowers not large; corolla pale blue-violet with white sharp tips above and

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underneath; anthers yellow or greenish-yellow, undeveloped; usually no natural fruit formation. Tubers white in the light, (get bluish under the skin in the spring); round-oval with pointed tip; eyes medium deep; pulp white; sprouts blue-violet. Economic qualities: medium-late table stock variety; very tasty; medium starch content; medium or below medium keeping quality; non-resistant to canker; temporarily admissable.

11 PARNASSIA VARIETY. Resembles Jubel variety. Plant well leafed; stem slightly pigmented, wings green; leaf with medium, shiny lobes and sharp veining. Bloom profuse; corolla red-violet with white sharp tips underneath; double flowered throughout on the outside; anthers orange, occasionally with red spots, wide; natural fruit formation. Tubers white, oval with blunt tips, medium deep eyes. Economic qualities: late table stock-industrial variety; high starch content; good keeping quality; resistant to canker; found in the Luga region (Leningrad oblast).

12 PAUL WAGNER VARIETY. Plant tall, well leafed; stem green; leaf small-lobed, dark green; occasionally ivy leafed; margins of lobes wavy. Bloom profuse and long; inflorescence half spread; flowers white; calyx pigmented with awl-shaped sharp tips; anthers orange, regular; stigma small, "golovchatoe"(?); ovary not colored inside; narrowing towards the tip. Tubers white, oval, with medium deep eyes; pulp white; sprouts (light) blue-violet. Economic qualities: medium-late table variety; of medium keeping quality; canker-resistant; regionalized as potential variety in Leningrad oblast.

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13 EARLY ROSE VARIETY. Local designations: Amerikanka, Early Maturing ("Skoropelka"); Early Pink, Pink. Plant low, well leafed; stem pigmented with drooping leaves; leaf slightly serrated; lobes wide, imbricate and margins strongly bearing down on end lobe; lobes smooth, shiny; bloom profuse, early, short; calyx green with long turned back leaf-life sharp tips; anthers orange; there is usually no natural fruit formation; tubers rose (pink) or red (color under skin), elongated-oval, slightly shallow; eyes small, occasionally protruding, numerous with long pronounced eyebrows; pulp white; a ring of red-violet pigment appears when sliced. Economic qualities: early table stock variety, tasty; strongly susceptible to phytophthora; suitable for light soils; poor keeping quality; non-canker-resistant; temporarily admissable.

14 SMYSLOVSKY (FÜRSTENKRONE) VARIETY. Plant wide, spread, with knee-like green stem, well leafed; leaf light green, slightly serrated; bloom profuse and prolonged (?); flowers large; corolla white; anthers orange, wide; fruit formation profuse; large fruit; tubers white, elongated-oval, slightly shallow with small eyes and white pulp. Economic qualities: medium maturing table stock-industrial variety, tasty; medium starch content and keeping quality; non-canker-resistant.

15 PHYTOPHTHORA-RESISTANT (8670). Produced in 1931 by the Institute of Potato Industry; obtained from a crossing of the wild potato Solanum demissum with the cultivated varieties Garnet and Narodny. Plant tall, upstanding; stem clearly pigmented in leaf axils; leaf dark green, slightly drooping, medium serrated; junction colored with blue-violet pigment; corolla

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blue-violet, with white sharp tips on both sides (deeper underneath); anthers small, bent; no fruit formation from natural self-pollination observed; tubers blue-violet, coloring is in skin; long-oval in shape, with small eyes on surface, more intensely colored (coloring of eyes both within and under the skin); pulp white. Economic qualities: medium-late maturing table stock variety; yield and starch content medium; resistant to phytophthora under field conditions; canker-resistant.

16 CENTIFOLIA VARIETY. In coloring of tubers and sprouts identical with BERLICHINGEN VARIETY and resembles it also in other characteristics; the distinction is in the following traits; flower is larger, paler; anthers regular; buds normally developed; calyx and upper part of peduncle green; fruit formation profuse, fruit large; leaf lighter; tubers less elongated. Non-canker-resistant; in sowings of the BERLICHINGEN VARIETY CENTIFOLIA represents an undesirable mixture.

17 ABERDEEN-FAVORITE VARIETY. Plant of medium height (to tall), well leafed; stem green, strong; leaf strongly serrated, large, long, dark-green, shiny; lobes long-elliptical, do not overlap; end lobe wavy at base. Bloom slight or medium, of short duration. Inflorescence consists of 3-4 whorls, of 5 flowers in each, with upper leaves; receptacle green of medium strength; corolla white with short lobes; calyx green; anthers not long, yellow or light orange; stem not long, frequently spiral-bent; thin, slightly raised above the anther column; no fruit formation; tubers white, roundish-oval; blunt, depressed tip and slightly depressed stolon; side eyes not deep;

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pulp white, darkens slightly in slicing; sprouts light red-violet. Economic qualities: medium maturing table stock variety; medium starch content and average keeping quality; susceptible to phytophthora and scab; canker-resistant.

18 EPICURE VARIETY. Plant tall, erect, scantily leafed; stem thick, pigmented; leaf strongly serrated; lobes smooth, shiny, dark-green; bloom profuse; inflorescence compact; corolla white; anthers yellow or green, frequently undeveloped; usually no natural fruit formation; tubers white, at late digging and in the spring pale rose ("flesh-colored"); barrel-shaped, frequently nodular, with deep eyes; white pulp. Economic qualities: Early maturing table stock variety; suitable for early growing; good keeping quality; non-canker-resistant.

19 JUBEL VARIETY. Plant scantily leafed, fairly tall; stem green of weak pigmentation in leaf axils; leaf medium serrated; lobes of leaves small, with bent down tips; wavy margins; shiny, dark green; sharp veining. Bloom early and profuse; inflorescence spread; corolla red-violet, large, with white sharp tips above and underneath; double flowered (on the exterior); calyx colored with awl-shaped (subulate) narrow and short sharp tips; anthers yellow or light orange, long; abundant pollen style long, raises above anthers; fruit formation; tubers white, oval-elongated, slightly shallow; eyes medium deep, occasionally nodular, fairly numerous; skin frequently rough; pulp white; sprouts red-violet. Economic qualities: medium maturing variety; medium starch content; suitable for many soils; good keeping quality;

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non-canker-resistant.

POTENTIAL VARIETIES

19 BALLYDOON VARIETY. Canker-resistant, medium-early to early maturing variety; tested under conditions of production in the Leningrad oblast. Resistant to some diseases of degeneration. Tubers roundish, white, with small eyes and white pulp; leaves dark green, medium serrated; inflorescence spread; consists of three whorls; receptacle green; peduncle dark green, thin; calyx deep, dark-green; has lanceolate-like sharp tips; corolla large, white, violet-tinted on the outside, occasionally double flowered; anthers yellow, long, wide, abundant pollen; form fruit occasionally; stem straight, raises slightly above anthers; stigma green, tall, flattened; ovary with narrowed tip, no anthocyanin inside.

20 DOON-EARLY VARIETY. Canker-resistant; early maturing, yieldy variety; tubers white; long-oval; large; sprouts red-violet; well leafed; upstanding; of medium height; leaf wide-lobed, smooth; flowers white with yellow anthers.

21 ARRAN-BANNER VARIETY. Canker-resistant, medium maturing variety of fairly early tuber formation; good yield; tubers white, roundish, large, with blunt, occasionally depressed tip and small side eyes; pulp white, darkens slightly in slicing; sprouts red-violet; plant tall, poorly leafed; leaves dark green, strongly serrated with sharp veining; inflorescence has long forks (Y-shaped); receptacle dark green, fairly long; peduncle long,

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dark green, junction in upper third part trimmed with thick, short, adpressed hairs; calyx dark green, deep, awl-shaped (subulate) sharp tips; corolla white, has rather narrow lobes and short sharp tips; anther column narrow, loose; anthers short, undeveloped, light-yellow or green; stem, slightly bent, rises above column; stigma slightly cornice-shaped, double-lobed, flattened, olive-green; ovary round with narrow tip.

End of Chapter

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Declassified and Approved For Release 2013/03/25 : CIA-RDP80R01426R009900010001-5

Bukasov, S. M. Kul'tura kartofelia (Potato Culture). Leningrad. Leningradskoe Gazetno-Zhurnal'noe i Knizhnoe Izd-vo, 1948. 228 p.
75 B86K

Translated in part by
S. M. Konson

METHODS OF POTATO SELECTION (p. 111-114)

Potatoes are propagated by seeds (the sexual method) and by the vegetative method (tubers, cuttings, runners, etc.). This peculiarity of potatoes determines the variability in its selection. In sexual propagation there occurs not infrequently extreme segregation: the most varied plants develop from seeds which resemble either the paternal or the maternal form or are a cross between the two. In vegetative propagation new plants grown from tubers do not differ, as a rule, from the maternal plant. Thus every new form of potato obtained as a result of sexual propagation may be easily fixed in propagating by the vegetative way. This represents a valuable asset in potato selection, as compared to the selection of other plants where reproduction is possible only the sexual way and where, because of hybrid segregation, it is occasionally almost impossible to preserve any valuable form.

Methods of selection in potatoes vary correspondingly, depending upon the peculiarities of potato propagation.

CLONAL SELECTION. A clone is the progeny of one plant in vegetative propagation. Consequently, clonal selection is reduced to the selection of the best plants (from an economical point of view) from which tubers are picked separately from each plant and subsequently propagated. Clonal selection is at present widely applied in seed potato growing for the

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purpose of obtaining the healthiest seed material of every potato variety that is being propagated. During clonal selection, however, as a measure of improvement, the most valuable ("polotsennyie") plants of a definite variety are separated. The variety itself does not change with respect to its most characteristic traits.

A new variety may also be produced by clonal selection. Cases have been known of changes in individual plants in any potato variety. This may be connected with the qualitative non-similarity of tissues of cells of a vegetative organism, as pointed out by Lysenko. Occasionally a clump of colored tubers may be found among plants of a yellow-tuber variety and vice versa. Similar modifications may pertain to the coloring of different parts of plants, the shape of leaves, flowers, tubers, as well as to a group of economically valuable characteristics, such as high yield and starch content, length of vegetative period, resistance to a variety of diseases, etc. It follows therefore that in clonal selection economically-valuable forms may be separated which in some traits differ from the original variety and may consequently be regarded as new varieties.

VEGETATIVE HYBRIDIZATION. Numerous data are available concerning the fact that in grafting a plant of one variety onto the plant of another variety it is possible to change the stock with the aid of the scion and vice versa. Changes may apply to many characteristics, including those of high yield, shape and color of tubers, early maturing, etc.

Lysenko considers that vegetative hybrids do not differ in principle from hybrids obtained by sexual method. The method of vegetative hybridization is at present being studied by a group of scientific research institutions.

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INTRA-SPECIES SELECTION. The present entire collection of existing selected potato varieties is derived from selection within the limits of almost exclusively one species, Solanum tuberosum. The first potato specimens which came to Europe differed in their fruit formation. In sowing their seeds a segregated progeny was obtained, from which selection was made, and this subsequently laid the foundation for the first potato varieties.

Potato selection proceeded for a long time along the path of planting seeds from berries that were formed the natural way. In this manner a considerable number of varieties was produced, a group of which did not lose its practical significance up to the present time (Early Rose). In crossing two different varieties, however, one may obtain a scope of variability among the progeny of hybrid plants, which widens the selector's opportunities for selection. In addition, prolonged self-pollination may in some cases lead to an increase of degenerative diseases and a lowering of the adjustability of a variety to external changes.

inter? The method of inter-species hybridization has produced a large quantity of contemporary potato varieties of high yield and starch content, rapid maturity, and canker-resistance, within the limits of only one species, that of S. tuberosum. Almost all standard USSR varieties were produced by this method. The same applies to the standard varieties of the Leningrad oblast.

There is no doubt that the method of intra-species hybridization is far from exhausted; this selection method will continue to be applied for

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a considerable time to grow new potato varieties of increased economically valuable qualities. In the course of the entire lengthy history of potato selection one was nevertheless unable to produce varieties distinguished by such exceptionally valuable economic characteristics as phytophthora and frost-resistance, etc. The efforts of selectors of the entire world directed towards these aims proved unsuccessful. Selection within the species Solanum tuberosum did not produce the desired results. It was necessary to search for new ways in selection work.

INTER-SPECIES SELECTION. Inter-species hybridization, as a method of selection, had its beginning following the receipt of a large variety of wild and new cultivated potato species from the expedition to Central and South America initiated by the All-Union Institute of Plant Industry. Some of these species possessed exceptional economically valuable qualities.

A study of these potatoes led to the discovery of species possessing altogether new characteristics of exceptional value as initial material for selection.

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Bukasov ... Potato Culture

PHYTOPHTHORA-RESISTANT POTATOES (p. 114-117)

In Mexico S. M. Bukasov discovered wild potatoes related to different botanical groups, resistant to phytophthora under natural conditions, as well as several forms which proved resistant even to artificial infection of foliage and tubers. These were the following species:

Group Demissa. Solanum varicosum, semi-demissum, demissum;

Group Longipedicellata. Solanum vallis mexicii, antipoviczii, ajuscoense;

Group Polyadenia. Solanum polyadenum;

Group Bulbocastana. S. bulbocastanum;

Group Cardiophylla. S. cardiophyllum, coloacanum.

All these species are very distant from the common potato varieties related to tuberosum. Some of the above potatoes were, nevertheless, crossed with tuberosum. This opened the possibility of conducting selection aimed especially at creating phytophthora-resistant varieties.

Hybrids of high yield were obtained from the wild species of antipoviczii; still it was not possible at the time to obtain hybrids that combined the complex of economically-valuable characteristics with phytophthora resistance. A group of inter-species hybrids were obtained from the wild species vallis mexicii, but it is not possible to date to estimate the value of this species as an initial material for producing varieties resistant to phytophthora.

The most practical and valuable species for producing phytophthora-resistant varieties proved to be the wild Mexican species Solanum demissum. One crossing

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of demissum with tuberosum does not produce hybrids of immediate practical significance. Hybrid plants of the first generation, while a step ahead in the direction of improving the economic qualities of the wilding, are, nevertheless, producing a typical wilding: long stolons, a frequently poor yield, irregular and poorly shaped tubers, etc. On the basis of numerous data it is possible to estimate that hybrids from threefold crossings of demissum with tuberosum represent material from which may be obtained forms that combine, along with phytophthora resistance, a complex of the remaining economic qualities.

Subsequent hybridization of triple (?) ("troinye") hybrids with tuberosum may be of interest in the event that the secured phytophthora-resistant triple hybrid will possess some shortcoming that may require elimination by crossing with a cultivated variety. Additional crossing with tuberosum weakens the family. If, however, an initial triple hybrid is distinguished by a high degree of resistance, one may expect a considerable quantity of phytophthora-resistant forms even in the four-fold crossing.

In 1933 the Institute of Potato Industry was first (in the world) to produce a phytophthora-resistant variety, 8670, obtained from the crossing of the variety Narodnii and the hybrid demissum X Granat X Granat. This variety proved canker-resistant as well. It was regionalized as a permissible variety for the Leningrad oblast. The variety possesses a number of deficiencies: susceptibility to the disease ("early blight" macroscorium solani, blue tubers etc. In some areas it also succumbed to more aggressive phytophthora races. In the Leningrad oblast the variety is until recently considered phytophthora-resistant under field conditions.

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In crossing the phytophthora-resistant variety, 8670 with some selected varieties we obtained a series of phytophthora-resistant hybrids of high yield.

At present the All-Union Institute of Plant Industry, the Institute of Potato Industry and other institutions have available a considerable number of phytophthora-resistant hybrids from demissum which have in part been already transferred for government varietal testing.

Phytophthora-resistant and valuable hybrids from demissum, in the complex of their economic characteristics, were later obtained from repeated crossings with tuberosum in Germany, the USA and England. In addition to hybrids from demissum, the Institute of Potato Industry produced phytophthora-resistant hybrids of high yields from repeated crossings of another Mexican wilding, the species semi-demissum with the tuberosum varieties. Thus in a brief space of time, by way of inter-species hybridization, aided primarily by the wild species demissum, phytophthora-resistant potato varieties have been produced for the first time in hundreds of years of potato growing. This represents a great achievement in selection work.

At present it is possible to recommend for productive testing, in conditions of the Leningrad oblast, the following phytophthora-resistant varieties: the hybrids Kameraz Nos. 1, 2, 3 and 4; Uralski, Krasnoufimski, 18883, Valle, etc.

FROST-RESISTANT POTATO SPECIES (p. 117-118)

Another valuable quality discovered in some species of South American potatoes was the frost resistance of their foliage. Frost-resistant species were discovered among wild, as well as cultivated potatoes.

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Highest frost resistance of foliage (minus 8° Centigrade) in our Leningrad conditions was observed in the group of wild species Acaulia, to which belonged three species: Solanum punae from Peru; Solanum depexum and Solanum schreiteri from Argentina.

The following wild species are distinguished by resistance of their foliage to frost at temperatures of minus 5°: S. demissum, semi-demissum, verrucosum (Mexico), S. bukasovii, abbottianum (Peru), henryi, orondii, commersonii, rionegrinum (Uruguay), millanii (Argentina).

In addition to wild potatoes, cultivated, so called primitive species, were discovered in Peru and Bolivia, distinguished by high frost resistance (minus 3-5°). Among these are: Solanum curtilobum, Solanum iuzepczukii, Solanum hanuiri (?).

Selection for frost resistance has so far not achieved significant results. It is true that with the aid of the phytophthora- and frost-resistant demissum, phytophthora-resistant varieties are frequently distinguished by slightly increased frost resistance, as compared with common varieties. The frost resistance of these hybrids is nevertheless not as pronounced and did not solve our problem. From among cultivated frost-resistant species Solanum curtilobum was widely introduced into hybridization. Already in the first generation, while repeatedly crossed with tuberosum, hybrids of extremely high yields of large and white tubers were obtained. The hybrid EPICURE X curtilobum was particularly outstanding by its high yield which frequently exceeded that of standard varieties. The relative frost resistance of these hybrids was, nevertheless, insignificant.

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SPECIES RESISTANT TO THE COLORADO BEETLE (p. 118)

Of much interest was the discovery of plants among South American potato species on which the Colorado beetle perishes at either the larva stage or while transforming into a pupa. Wild potatoes from Mexico, Uruguay and Argentina belong to the following species: Solanum jamesii, polyadenum, demissum (Mexico), S. henryi, commersonii (Uruguay); S. millanii, dolichostigma (Argentina), etc.

SPECIES HAVING TUBERS NOT REQUIRING PERIODS OF DORMANCY (p. 118-120)

Among the South American material were found altogether unusual potatoes the tubers of which do not require dormancy and are capable of germinating immediately after harvesting. These new cultivated, so called "primitive" species are: S. boliacense, rybinii, sieae (Colombia); S. caniarense, kesselbrenneri (Ecuador); S. phureja (Bolivia).

Forms of tubers not requiring dormancy were discovered also within the limits of a new cultivated species, S. andigena. The forms were: rosaada (Colombia), tunguraiense, flaviculum, caramum (Ecuador).

Thus the task of producing potato varieties of two to three yields by planting with freshly-dug tubers became a reality.

The availability of similar material is equally valuable in another respect. In producing early potato varieties for the northern part of the USSR, including the Leningrad oblast, it is important to grow tubers that have the capacity of germinating and producing shoots in soil that is not warm enough. In such case it would be possible to obtain early shoots under field conditions

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which, along with somewhat increased frost resistance of the foliage, would ensure the production of maximum early potato yields.

The Polar Department of the All-Union Institute of Plant Industry obtained a large number of hybrids from one of the species of this group, boiacense, which when crossed with different varieties of tuberosum, ~~that were~~ was suitable for planting with freshly-dug tubers. Tests of a series of similar hybrids, chiefly EPICURE X boiacense, produced under southern conditions extremely satisfactory results. These hybrids are being widely propagated especially in the Krasnodar territory and Central Asia.

PRODUCTION OF EARLY MATURING POTATO VARIETIES (p. 120-121)

Despite the deficient ("zatrudnennie") tuber formation of South American potatoes and their late maturing under our latitudes, we obtained rapidly maturing hybrids of high yield with the aid of some South American forms. Of particular value as an initial material for selection were some forms of Solanum andigena. Best results were obtained from introducing into selection those forms of andigena which are distinguished by a relatively higher tuber formation during a long day, such as the Colombian forms of tocanum, hederiform, uamense, the Peruvian kochuanum, the Bolivian longibaccatum, etc.

At the Polar Division of the All-Union Institute of Plant Industry, I. A. and M. N. Veselovski produced a series of hybrids with the aid of andigena which considerably exceeded standard varieties in yield (in some cases the yield exceeded the standard by 200 per cent and over), were distinguished by early tuber formation and had the desired complex of other economic qualities.

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From one crossing of JUBEL X andigena, form tocanum, the early canker-resistant variety IMANDRA was obtained which was regionalized for the Murmansk oblast. From the planting of seeds of the second generation of the hybrid EPICURE X andigena, var. longibaccatum, M. M. Khrennikova produced at the Igar station of the Institute of Polar Agriculture the seedlings Nos. 96 and 101, which under the severe conditions of the Enissei north exceeded in yield and early maturing all the rest of the tested varieties. These seedlings are widely propagated at present in the Soviet Polar region.

The method of dual hybridization of andigena with tuberosum proved also valuable for the production of early varieties. According to Veselovski, the most responsive among them proved to be those families where an early selective variety was taken as a maternal plant and pollinated by the hybrid andigena X early or medium selected varieties.

SPECIES POSSESSING INCREASED ALBUMEN CONTENT IN TUBERS (p. 121)

South American species may be arranged in the following order, according to the diminishing content of albumen (raw protein) in the raw mass of tubers:

Wild Species (in percentage):

Solanum semi-demissum, Mexico . . . . . to 5.13 - 6.8
" demissum " . . . . . to 4.91
" vallis mexici " . . . . . to 4.63
" arrace-papa Peru . . . . . to 4.58

Cultivated Primitive Species (in percentage):

Solanum phureja, Bolivia . . . . . to 4.33
" curtilobum, Bolivia, Peru . . . . to 3.92
" ahanuiri, Bolivia . . . . . to 3.80
" mamilliferum, Peru . . . . . to 3.77
" rhybinii, Colombia . . . . . to 3.40, etc.

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The increase of the content of raw protein in tubers was observed in only a few forms of the new cultivated species andigena, such as latacungense, up to 5.83 per cent, and others.

STARCH CONTENT OF TUBERS IN SOUTH AMERICAN POTATOES (p. 121-122)

Among different species of South American wild and cultivated potatoes there are forms having totally different starch content in tubers. As a rule, almost all wild species possess high starch content which reaches 20 per cent and over. The highest starch content in tubers (to 26 per cent) was found in S. dolichostigma, antipoviczii (var. reddicii), certain varieties of demissum, semi-demissum, etc. In the wild Chilean species the starch content usually averages 19 per cent. The wild Chilean species S. leptostigma produced in crossings with different varieties of tuberosum a hybrid progeny of extremely high starch content.

Numerous forms of the new cultivated species of andigena usually averaged a starch content of less than 20 per cent. The maximum starch content (23.3 per cent) was found in the Colombian form tucorenia.

Among Chilean cultivated potatoes related to S. tuberosum, we also find a series of forms containing 20-21 per cent of starch in tubers. The highest starch content (occasionally 25 per cent) is possessed by the form picunia. Of particular value is the circumstance that in inter-species hybridization, especially with the species most important for selection, demissum, some forms with exceptionally high starch content were occasionally obtained (exceeding at times 30 per cent), such as our triple hybrid (Epicure X demissum) X Lutsov X Goldstarke, and many others.

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Aside from wild species, hybrids of high starch content were obtained also from crossings with South American cultivated potatoes; specifically, with some forms of andigena: tuberania, cusi, tocanum, funsanum, errore, longibaccatum, kechuanum, etc. In obtaining hybrid forms of high starch content the proper selection of pairs (?) from tuberosum is of great significance. Thus, for instance, good results are obtained from the inclusion into crossings of the starchy canker-resistant varieties: Stärkeragis, Ostbote, Goldstärke, etc.

POTATOES POSSESSING HIGH CONTENT OF ANTI-SCURVY VITAMIN IN TUBERS (p. 122)

Potatoes represent the principal source of anti-scurvy nutrition for large masses of the population, because of the presence of the anti-scurvy vitamin C in potato tubers.

It is therefore natural that an increase of the content of vitamin C in potato tubers is of much significance. Among all tested potatoes an exceptionally high content of vitamin C was discovered in the Mexican wild phytophthora-resistant species Solanum antipoviczii.

The foliage of some varieties of S. antipoviczii lack almost completely solanine and may consequently safely serve as fodder for livestock.

CANKER RESISTANCE OF SOUTH AMERICAN POTATOES (p. 122-123)

The value of South American potatoes as an initial material is further increased for purposes of selection because approximately 50 per cent of tested specimens possess canker resistance. This offers the possibility of obtaining a large number of canker-resistant varieties in the hybrid progeny.

Up to the present time races of potato canker were unknown. Only the actual inducer of canker, the fungus Synchitrium endobioticum was known.

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Potato varieties not affected by canker through artificial infection and when grown in infected soil under natural conditions were considered canker-resistant.

Lately in Thuringia (Germany) a new potato canker race was discovered which struck all canker-resistant varieties except the variety Fram and several hybrids. One of the forms of S. andigena participated in the creation of this variety. It is possible that among South American potatoes, specifically andigena, there are forms resistant to the most aggressive canker races. This circumstance further increases the importance and value of South American species as an initial material for the production of varieties resistant to the more aggressive potato canker races. In studying at canker laboratories our potential hybrids the parents of which were selected for canker resistance, it was established that three quarters of all hybrids possessed canker resistance. It is therefore desirable to utilize the canker-resistant varieties of tuberosum in inter-species hybridization to increase the number of canker-resistant hybrids within a family.

RELATION OF SOUTH AMERICAN POTATOES TO DEGENERATION AS A DISEASE (p. 123)

The majority of South American potatoes when getting into ecologically alien geographical conditions, after many years of reproduction in the Leningrad oblast (to an even greater degree in southern areas), produce symptoms of degeneration and develop so-called virus diseases. The availability among South American potatoes of such forms which did not produce these symptoms after being exposed to our conditions for a long time and did not suffer from virus diseases carries consequently still greater importance.

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Among these potatoes are the wild Chilean species Solanum maglia, the Chilean variety Solanum tuberosum Villaroela; the cultivated primitive species kesselbrenneri (Ecuador). Similar forms should be introduced into selection by creating potato varieties resistant to degeneration and virus diseases.

SELECTION OF VARIETIES OF SOLANUM TUBEROSUM FOR CROSSINGS IN INTER-SPECIES HYBRIDIZATION (p. 123)

South American potatoes may, as a rule, be utilized only as initial material in selection for crossings with the best potato varieties of the species tuberosum and those distinguished by canker resistance.

South American potatoes are usually characterized by poor yield and late tuber formation under conditions of a long day. Selection of tuberosum varieties of early tuber formation is therefore particularly important.

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INITIAL MATERIAL FOR POTATO SELECTION IMPORTED BY THE EXPEDITIONS OF THE ALL-UNION INSTITUTE OF PLANT INDUSTRY FROM CENTRAL AND SOUTH AMERICAN COUNTRIES (p. 124)

Names of Species	Place of Origin	No. of chromosomes	Presence of Economically Valuable Characteristics								
			Phytophthora resistance	Frost resistance	Resistance to Colorado beetle	Absence of period of dormancy	Increased albumen content in tubers	Increased starch content in tubers	Increased content of vitamin C in tubers	Resistance to degeneration	Canker resistance
WILD SPECIES											
Solanum demissum	Mexico	72	✓	✓	✓		✓	✓			✓[1]
" semi-demissum	"	60	✓	✓			✓	✓			
" verricosum	"	24	✓	✓							
" Vallis mexici	"	36	✓				✓	✓			
" antipoviczi	"	48	✓					✓	✓		✓[1]
" ajuscoense	"	48	✓								
" cardiophyllum	"	24	✓								
" coicoacanum	"	36	✓								
" polyadenium	"	24	✓		✓						
" bulbocastanum	"	24	✓								
" jamesii	"	24			✓			✓			✓
" punae	Peru	48		✓				✓			
" aracc-papa	"	24					✓	✓			
" bukasovii	"	24		✓							
" abbottianum	"	24		✓							
" depexum	Argentina	48		✓				✓			
" schreiteri	"	48		✓				✓			
" millanii	"	36		✓	✓			✓			

[1] Some varieties

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Names of Species	Place of Origin	No. of Chromosomes	Presence of Economically Valuable Characteristics								
			Phytophthora resistance	Frost resistance	Resistance to Colorado beetle	Absence of period of dormancy	Increased albumen content in tubers	Increased starch content in tubers	Increased content of vitamin C in tubers	Resistance to degeneration	Canker resistance
Solanum parodii	Argentina	24			✓						
" dolichostigma	"	24			✓			✓			
" henryi	Uruguay	24		✓	✓						
" commersonii	"	36		✓	✓			✓			✓
" Orondii	"	24		✓							
" rionegrinum	"	24		✓						✓	
" maglia	Chile	36						✓			✓
" leptostigma	"	48									
CULTIVATED SPECIES											
Solanum rhybinii	Columbia	24				✓	✓				
" boyacense	"	24				✓					
" siese	"	24				✓					
" canariense	Ecuador	24				✓					
" kesselbrenneri	"	24				✓				✓	
" ahanuirii	Bolivia	24		✓			✓				✓
" curtilobum	"	60		✓			✓				
" iuzepchukii	"	36		✓							
" pureha	"	24				✓	✓				
" mamilliferum	Peru	36					✓				
" andigena	Mexico, Colombia, Ecuador, Peru, Bolivia	48				✓[1]	✓[1]	✓[1]			✓[1]
" tuberosum	Chile	48					✓[1]	✓[1]		✓[1]	✓[1]

[1] Some forms

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The assortment of early varieties presenting considerable significance for inter-species hybridization is extremely limited. Consequently non-canker-resistant early varieties have to be drawn upon in some instances for crossings in addition to canker-resistant varieties. The only canker-resistant early variety, regionalized for the Leningrad oblast up to this time is the var. COBBLER, which frequently produces a progeny of high yield. This variety may be utilized as a maternal or paternal plant, although there usually is not much pollen in the anthers.

From among the non-canker-resistant early varieties distributed in the Leningrad oblast the varieties EARLY ROSE, EPICURE AND EPRON may be utilized in inter-species hybridization usually as maternal plants.

Drawing into hybridization the most rapidly maturing (in the world) non-canker-resistant variety VARBA and the new canker-resistant varieties DUK-EARLY, FRÜHBOTE, FRÜHMELIE, CERULIA, as well as the variety BALLYDOON, the latter distinguished by early tuber formation, is also desirable.

In addition to early varieties and those of early tuber formation, varieties of late maturing should also be utilized, beginning with the canker-resistant and regionalized for Leningrad oblast varieties BERLICHINGEN, MAJESTIC, JUBEL, etc., as well as those not regionalized but prevailing in the oblast and producing good results in hybridization, such as KATAHDIN, SIEKINGEN, ROON, PARNASSIA, PEPO.

From among the new canker-resistant varieties known as good breeders for the production of late varieties of high starch content, the following varieties deserve mentioning - OSTBOTE and STARKEKRAGIS.

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Fair results in hybridization may be obtained from the non-canker-resistant varieties CENTIFOLIA, SWEETEZ, KOREMEVSKI, LORKH, ALMA, SMYSLOVSKI.

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(31)

Bukasov, S. M., and Lebedeva, N. A.
Michurinskie metody v selektsii kartofelia
(Michurinite methods in potato breeding)
Leningrad. 1949 70 p.
632.941

February 2, 1951

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TASKS IN POTATO SELECTION (p. 3-11)

Potatoes are second to bread only. In gross yield and cost they compete with the basic bread of the earth, wheat. However, losses suffered in potato crops are far from small and are determined by the degree of destructiveness of pests and especially diseases. Potatoes suffer frequently also from unfavorable external conditions.

Selectors have for a long time attempted to control potato diseases and the damage caused by frosts, in addition to creating new resistant potato varieties. Nevertheless, all attempts to produce varieties of a new type, such as varieties resistant to photophthora, were unsuccessful so long as old selection methods were on a wrong track.

It took Michurin's teachings to show Soviet selection the proper direction for solving the tasks they were faced with.

I. V. Michurin's theories teach how to transform the nature of plants and animals in a direction desirable to man. At present a large army of scientists-Michurinists, headed by the academician T. D. Lysenko, are in close contact with practical work performed at state and collective farms, and shock workers in socialist agriculture, and continue to develop Michurin teachings.

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In applying widely Michurin methods for producing new and improved old varieties, Soviet scientists have already achieved large successes. Much interesting material has also been secured in securing new potato varieties, especially those resistant to phytophthora.

Hybridization, according to Michurin principles, involving training, was widely used in potato selection.

In the field of potato selection other Michurin methods are equally used. Potatoes offer an irreplaceable object in vegetative hybridization, of vegetative "rapprochement," directed training, clonal selection, the utilization of genetic qualitative distinction in tissues, and other Michurin selection methods. The application of Michurin's teachings to potato selection, its reconstruction to meet the new tempo, essential for the Soviet epoch in our country, is of particular importance, every achievement in this field having a colossal significance because of the prominent place potatoes occupy in the economy of our country.

I. V. Michurin named one of his articles: "Selection is the lever for obtaining plants immune against diseases and pests."

Here he stressed that . . . "the only proper way to practice control was through selection and hybridization which provided the possibility of obtaining new varieties immune against diseases and pests."

The particular attention which Michurin devoted to wild progenitors was responsible for the complete reconstruction of potato selection, i.e., establishing it on the utilization of its wild ancestors.

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Potatoes came to Western Europe and to the USSR from South America. To utilize the wild progenitors of potatoes it was necessary to study and gather them on location in South America and Mexico. The All-Union Institute of Plant Industry (VIR) organized in 1925 an expedition for the purpose. This expedition, undertaken by Bukasov and Iusepchuk, crossed thousands of kilometers in the high mountainous regions of South America and Mexico, which had received little study, were accessible with difficulty, and inhabited by Indians who had preserved the culture and potato varieties of pre-Columbus days. The expedition collected thousands of potato specimens grown for centuries by the natives, as well as numerous wild potatoes. Altogether new valuable characteristics were discovered of potato species previously unknown to science. Wild potatoes resistant to potato rot (phytophthora) and frost, producing two yields a year, and resistant to the most dangerous potato pest, the Colorado beetle.

Specimens collected by the expedition were subjected to study under various conditions in subsequent years.

Once the wild potato varieties had been examined, which represented the first stage of the work, the next stage was attempted, i.e., to hybridize wildings with our cultivated varieties in order to provide the latter with the valuable characteristics of the stock plants. Hybridization with wild potatoes is an exceptionally complicated task. "In crossing our cultivated varieties of fruits with genuine wildings of the same plant species," writes Michurin, "it is necessary to take into account that the latter, in view of their lengthy life and resistance invariably possess a particularly strong capacity to transmit

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their characteristics to their progeny and that as a result hybrids of the first generation acquire predominantly the characteristics of their wild forefathers."

Along with the valuable traits possessed by wildings, the first progeny generation is endowed with harmful traits, such as poor yield, long stolons, etc. This leads to the third stage of the work. Here Michurin states: "The most important task in producing new varieties of fruits is the third method, that of the repeated crossing of hybrids with the best cultivated and foreign varieties. In applying this method we may proceed in the direction of expedient training in developing seedlings."

All of the work of VIR, with respect to producing phytophthora-resistant potato varieties, meets fully the principles established by Michurin. VIR produced a group of phytophthora-resistant potato varieties: Kameraz 1, Krasno-Ufimskii, Uralskii, etc. In producing the above varieties the inter-species method of hybridization was applied with potato wildings from Mexico, Solanum demissum, followed by the subsequent training of hybrid seedlings. Thus Soviet scientists solved one of the most important tasks in potato industry, the creation of varieties resistant to phytophthora.

The second task in potato selection was to create varieties for the extreme North. This was also solved in the Soviet Union. The work of the academician I. G. Eichfeld showed the possibility of growing and obtaining high potato yields in the Far North. Severe climatic conditions

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of that region reacted unfavorably upon the quality of northern potatoes. They were of a watery, poorly tasting quality. Here too, Michurin's teachings came to the researchers' aid. Professor I. A. Veselovskii widely applied inter-species hybridization of cultivated potato plants with the South American potato species Solanum andigenum, known for its high starch content.

Succeeding directed training of hybrid seedlings, engaged in over a period of years under severe conditions of the extreme North, aided by high agricultural practices, produced varieties of new types for northern regions.

These varieties - Imandra, Igarskii, etc., now produce yields up to 400 centners per hectare and over. They possess good tasting and keeping qualities and stand lengthy transportation well, a factor of considerable importance in the immeasurable spaces of our North. They are now widely introduced into production. Varieties trained under severe northern conditions possess a certain degree of frost-resistance and the capacity to grow rapidly in instances where early frosts destroy foliage. In the extreme North, the teachings of I. V. Michurin and his talented pupil T. D. Lysenko also assisted in solving the third task in potato selection, that of producing varieties giving two yields a year.

The prolonged vegetative period in the south of our country, the Crimea, Caucasus and Central Asia, is long enough to yield two harvests annually. In these regions potatoes planted in early spring ripen by June. This leaves four months of warm weather still favorable for potato growth unutilized before early frosts set in. The July heat interferes,

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however, with the growth of early potato varieties, causing the foliage to dry out. The heat contributes also to the development of some potato diseases. The remaining foliage of late potato varieties wilts because of the heat, as is the case in the Northern Caucasus. However, even if late varieties are made to survive the hot months of the year successfully, their yield will still not produce suitable seeds because potato tubers formed during hot months degenerate and produce, when planted, shriveled specimens of insignificant yield.

Lysenko noted the degeneration of potatoes at high temperatures of the soil. He introduced wide-scale summer plantings into production. Tubers thus received a chance to form in cool fall months and degeneration stopped. The summer planting of potatoes radically improved the seed quality of potatoes. In addition, yields from summer plantings occasionally exceeded those of spring planting; summer plantings, therefore, represented a veritable revolution in the southern potato industry of the USSR.

The introduction of summer plantings raised a series of new problems in potato cultivation. It was necessary to search for new methods in agricultural practices, particularly with respect to potato storing. The storage of seed potatoes, even prior to spring planting, had been difficult. It required careful sorting, good storage facilities, proper care during storage. It was still more difficult to store seed potatoes prior to summer planting, i.e., before the middle of the summer when summer planting begins. All these difficulties were overcome by special methods developed by Lysenko in storing seed potatoes prior to summer plantings. Nevertheless, it remained tempting and more profitable for

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households not to preserve the previous year's potatoes for summer plantings but instead to use potatoes of spring plantings if these were harvested in the summer.

The planting of potatoes in the summer with freshly harvested tubers proved a complicated task. Freshly dug potato tubers do not germinate for a long time because they spend considerable time in a dormant state. Tubers of early varieties require particularly long dormancy, although it would seem they would germinate earlier than late varieties. It is true that spring tubers of early varieties germinate earlier than do tubers of late varieties. When freshly dug tubers are planted in the summer, however, early varieties germinate even later than late varieties.

In planting freshly dug tubers in the summer, time is consequently lost which the plant could spend on growth and the accumulation of yield. Scientists have repeatedly tried to find means to reduce the dormancy period in potato tubers. Chemical substances were discovered which when applied to tubers reduced the dormant state. But these chemical stimulants (accelerators) are not practical for use on a productive scale because of the complicated treatment they involve.

In searching for a simpler method for reducing dormancy in potato tubers Lysenko proposed to cut freshly harvested tubers. But this method also had its disadvantages. In cutting, disease is unavoidably transmitted and part of the tubers are destroyed. In addition, this method requires much time and space.

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The problem therefore arose anew as to whether potatoes could not be planted by using freshly-dug tubers, immediately following harvesting, without preliminary treatment of the seed material.

Planting of freshly harvested potato tubers without preliminary treatment had not been attempted in any European country, nor in the USA, none of the thousands of known varieties being suited for the purpose. The lack of success was explained by the fact that selected potato varieties produced in Europe and the USA formed fundamentally part of a numerous family, representing progenies of several potato tubers imported over four hundred years ago by Spaniards from the potato regions of Chile, i.e., actually from only one section of the vast territory where ancient Indian potato culture stretched thousands of kilometers northward to Columbia, Venezuela and Mexico. In this immense territory of ancient potato culture, the Indians have grown over a period of thousands of years, altogether distinctive potato species, not resembling the common potato we are used to see in our fields.

The mountainous regions of the Andes (Cordillera) of South America (where potatoes are grown) stretch to a considerable height, 4,419 meters above sea level. Deep, unpassable valleys separate one region from the adjoining one. Close to the Equator, high in the mountains, there is no winter, and cultivation of potatoes is possible here throughout the entire year. Dry months periodically interrupt the growth of potatoes. They are planted there not only once a year, in the spring, as done by us, but two and three times a year; and harvests are correspondingly obtained as many times.

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All these facts related to Indian potato culture became known to us only in the past years as a result of the painstaking study of conditions of potato growth in the country of its origin, i. e., South America. The study and gathering of South American specimens of potatoes were performed by Soviet scientists, S. M. Bukasov and S. V. Iusepchuk, professors of the All-Union Institute of Potato Industry.

Bukasov first discovered and described the Columbian potato species Solanum Rybinii, so named after the outstanding Soviet scientist V. A. Rybin, who participated in the study of new potatoes. Tubers of this potato do not require a state of dormancy and after being freshly dug germinate immediately when planted. This proved to be the potato so essential for the south of our country, which prophesied a revolution in southern potato growing.

The task consisted in introducing this potato to Russian soil. Yields of this potato in our northern conditions proved, however, much smaller than those of our common potato varieties.

This example supported Michurin's conclusion concerning the fallacy of the possibility of acclimatizing southern plants by way of ordinary transplanting into other environments.

Soviet selectors faced a difficult task: to combine the new quality of potatoes, absence of dormancy, with the high productivity of our varieties.

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Two-yield hybrid varieties could be produced in the extreme North for the southern USSR. This was done; the results were: the varieties: Khibinsk two-yield and Khibinsk early-maturing. These early varieties exceed in yield many previously known potato varieties and are suitable for planting with freshly-dug untreated tubers. In the spring of 1948 potatoes of new varieties grown in the Krasnodar region were already sold in Moscow stores. Thus Soviet scientists managed to solve in a relatively brief time a problem which foreign scientists had been unable to solve for centuries.

Using as a basis Michurin's and Lysenko's teachings, Soviet scientists engaged also in the production of potato varieties possessing generally valuable characteristics, frost-resistant varieties in particular.

The foliage of the common potato varieties is tender and unable to stand even light frosts. Michurin pointed to a clear and safe way of creating frost-resistant varieties. He wrote: "In trying to endow a tender plant with greater resistance to frost, we cross it with wild-growing resistant varieties of the same species." Wild potatoes grow in their native country, the mountains of South America, on very high mountain summits, almost up to 5,000 m. above sea level; i. e., close to the border of eternal snows.

The high-mountain potato wildings, grown in conditions of perpetual frosts, possess frost resistance. Their foliage does not freeze

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even at 10° below zero. These frost-resistant varieties were gathered by the Soviet expedition and used in producing frost-resistant domestic varieties.

In crossing frost-resistant wildings with cultivated plants it is necessary to observe all Michurin methods on overcoming non-crossability, i.e., the vegetative "rapprochement" by graft, etc. Michurin methods offer the opportunity to obtain a large hybrid progeny which may be trained to become frost-resistant. Our northern regions are in dire need of these frost-resistant varieties, including the Leningrad oblast, where frosts frequently occur in the spring and fall. In addition, the important problem of obtaining early potatoes is also connected with the production of frost-resistant varieties, capable in the first stages of their growth and development to withstand light frosts.

In connection with the threat of the penetration of the dreadful potato pest, the Colorado beetle, the task of producing potato varieties resistant to it has also become the order of the day.

HYBRIDIZATION OF POTATOES (p. 12-13)

All these and other practical demands compel selectors to search for new ways in producing new potato varieties. One of the important methods of contemporary selection is hybridization combined with subsequent selection and the training of hybrid progeny, which offer the opportunity to obtain new potato varieties in a relatively short time.

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Inter-species hybridization of potatoes is valuable because it offers a chance to provide varieties possessing different new qualities: phytophthora- and frost-resistance, etc., which cannot be obtained by inter-varietal hybridization or by ordinary selection, particularly since within the limits of the species Solanum tuberosum, to which all cultivated potato varieties belong, these qualities are unknown. Inter-varietal hybridization is, nevertheless, not an outdated method and many problems of selection may be solved with its help. They serve, for instance, for the purpose of providing canker-resistance to such valuable varieties as Lorkh or Early Rose, etc.

Directed training, the utilization of genetic qualitative distinction in tissues may widen selection possibilities beyond the limits of characteristics of species.

By using the method of directed training, P. F. Medvedev produced double yield varieties at the Kuban station of VIR, without taking recourse to hybridization. Summer plantings offer the opportunity to change the speed of varietal ripening. Clonal selection, especially based on the utilization of genetic qualitative differences of tissues, increases yields and starch content, speeds up ripening, changes the color of tubers and other characteristics.

Certain tasks in selection can, however, only be solved by inter-species hybridization. How else could one produce a potato variety resistant to injuries caused by the Colorado beetle in our country, without using inter-species hybridization? It would otherwise be necessary

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to wait until this pest actually enters our country and destroys potatoes on hundreds and thousands of hectares, while the selector would be waiting for the appearance of certain individual specimens of plants that would have escaped injury to continue further selection work. This is a long and wasteful procedure, called by Michurin "pitiful treasure hunting."

"Nature changes the structure of live organisms by adjusting them slowly to environmental surroundings in a degree hardly noticeable in the course of literally thousands of years. By utilizing the method of artificial cross pollination (hybridization) one manages to produce in hybrid plants in relatively short periods significant changes leading gradually to complete resistance in conditions of repeated crossing over a period of several years." Michurin points to the direction genuine science should follow: "Not to wait for the accidental appearance of a desired trait but to create with the aid of hybridization new organisms of new heredity with the required combination of qualities." This does not indicate that other methods, such as segregation, do not play any role in contemporary selection. They have not become obsolete, have not lost their significance, but in the creation of new forms of new heredity they maintain a subordinate role with regard to hybridization.

SELECTION OF PARENT PAIRS (p. 13-16)

The primary stage in hybridization is the selection of parental pairs for crossing. A selector should not cross indiscriminately "all with everything" in the hope that he may somewhere find a suitable

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combination of useful traits. He should, first of all, clearly determine the type of plant he intends to produce, what its heredity should be, what principal characteristics the new variety should possess. Then only, depending upon these aims, the experimenter selects his parental plants.

To obtain, for instance, a frost-resistant potato variety, it is not possible to use exclusively cultivated plants in crossing, since none of them possess frost-resistance. This equally applies to the production of varieties resistant to the Colorado beetle. Then it is necessary to take recourse to crossings of wild potato species with selected varieties. The former, as already indicated above, grow in South America and Mexico. Numerous specimens of wildings and primitive cultivated species of potatoes were brought over by Soviet expeditions in the years 1925-1927 and in 1932. In their native country, wild potato species are harmful weeds. Among potato wildings there is a group of frost-resistant varieties, Acaulia, which includes the following species: Solanum Schreiteri, S. punal, S. depexum, of which the foliage is frost-resistant to minus 8° There are also species resistant to the Colorado beetle, the group of species Commersoniana (Solanum hibberulesum, S. parodii, S. Schickii), distinguished at the same time by a strong growth of the clump.

Some wild species are distinguished by their resistance to phytophthora (Solanum demissum, S. antipovichii); but all potato species possess, along with valuable and desirable qualities, some pronounced shortcomings; their yield is insignificant, the tubers small, the cluster extremely spread, stolons sometimes 1 m. long, tubers of poor taste.

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The second parent plant should be selected from cultivated varieties. It is to be kept in mind that among cultivated varieties sterility is widely spread. The pollen of these varieties are non-viable in the majority of cases and may not be used for pollination. Such varieties may serve only as maternal plants. In crossings with frost-resistant species of the Acaulia group it is essential to select the second parent from the group of fertile cultivated varieties since the above frost-resistant species in crossings with cultivated varieties may not be used as pollinizers: their short pollen tubes (?) do not reach the ovules of cultivated varieties. In addition it is desirable to select for crossings only canker-resistant varieties because non-canker-resistant varieties are scheduled for replacement by canker-resistant varieties in different regions of the Union. The hybrid progeny usually produces tubers that are too late in forming, and it is therefore necessary to select predominantly early cultivated varieties for crossings with wild species, the latter, as a rule, having a long vegetative period. In choosing a cultivated "producer," attention has to be directed to the size and shape of the tubers, the shape and depth of their eyes, the coloring of the skin, the length of stolons, the color of the tuber flesh, the percentage of starch content in tubers. It is desirable to use in crossings varieties of large smooth tubers, with small eyes. Preference should be given white or light colored tubers; varieties with dark-colored tubers produce a high percentage of loss in harvesting. White flesh varieties are preferable.

The variety selected for crossing should have a compact cluster in which the tubers are clustered on short stolons. Varieties having

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spreading clusters should be avoided because hybrids obtained from their crossing with wildings usually also have non-compact clusters. Spreading clusters cause considerable inconvenience and unnecessary losses in harvesting. A high percentage of starch content is a desirable characteristic in a producer plant since starchiness ensures high yield of dry substance.

In hybridization the historical past of every parent is taken into consideration; i.e., the conditions in which each parent had developed over a period of many decades and even centuries. Michurin advises to select parents from distant locations to avoid a one-sided transfer of hereditary characteristics in the hybrid plant. He wrote: "The further apart are pairs of crossed producer plants from each other in location and environmental conditions, the easier will hybrid seedlings adjust to the environment of the new location."

Of much significance for the heredity of the hybrid is the age of the potato variety. The younger the variety, the less strength it has for hereditary transmittance and inversely, older varieties possess greater strength for hereditary transmittance. Wild potato species are strongest in transmitting their hereditary characteristics to hybrids.

It is further of importance as to which plant in a given pair is chosen as a female or male parent. Michurin wrote concerning this: "In selecting a combination of pairs of plants for crossings, the female role should be assigned to specimens of relatively better qualities because the female plant usually transmits its characteristics to the hybrid in greater measure."

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CROSSING (p. 16-18)

Once the parental pairs have been selected crossing follows. Some of the wild potato species cross relatively easily with selected cultivated varieties, such as the wild phytophthora-resistant species Solanum demissum. This may equally be said of the majority of primitive cultivated species. The entire success in crossings with these species depends primarily upon the technique of crossing and the conditions under which the crossing takes place.

Healthy, well developed plants are selected for crossing, since this is the primary prerequisite for obtaining healthy, viable progeny. The selected cyme or bunch of flowers should not be too young; a portion of the buds should already be open. Older buds are selected for emasculation and crossing because if a bud is too young its stigma is not prepared for receiving the pollen, it is too tender and in emasculating may easily dry out; all young buds are therefore removed. A small parchment label on a flaxen thread is then affixed to the stalk of the cyme and the name of the maternal variety written on it, the date and hour of the crossing, and the number of pollinated buds on the cyme. Next follows the emasculating of buds. The operator holds the bud at its point of attachment to the peduncle with his left hand, while his right holds the forceps dipped in alcohol. The petals of the bud are gently pushed open and the anthers removed one after the other. One should carefully observe whether the anthers are closed; if they are open, pollination may already have taken place and such bud must then be eliminated from the cyme.

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In emasculating care should be exercised not to permit the forceps or needle to touch the stigma, as even a slight touch may cause it to dry out. The next step following emasculation is to immediately place the pollen upon the stigma of the emasculated buds. The pollen is previously shaken from the anthers of the male parent plant and gathered into a thin glass tube or, which is better, shaken upon the stigma of emasculated buds directly from the anthers. In pollinating the stigma should not be touched. It is advisable to dust the pollen at a distance of 2-3 mm from the stigma.

The time chosen for crossing is also important. Our experience has shown that the largest percentage of germinated berries occurred from pollination in the evening hours (from 5 to 10 p.m.), a much smaller percentage during the morning hours (8-12 noon) and that only rare fertilization from pollination takes place between 12 p.m. and 5 p.m. On cloudy, foggy days the time of crossing is of no significance. A parchment "isolator" is placed upon the pollinated cymes, which is tied at the"neck"with a thin wire. After 10-12 days the "isolator" is removed and the fertilization of the fruit verified. During these 10-12 days the "isolator" should be opened twice for airing.

If the berries were fertilized, the isolator should be replaced upon the cyme because the berries of some species and varieties easily drop, especially before ripening. In the fall the berries are removed and transferred into a safe place of room temperature where they complete their ripening. When the berries are soft the seeds are extracted, dried and placed in packages.

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METHODS FOR OVERCOMING NON-CROSSABILITY (p. 18-43)

Many of the wild species of potatoes cross poorly with cultivated selective varieties. Among them are the frost-resistant species of the group Acaulia, Solanum Schreiteri, S. punal, S. depexum; the species of the group Commersoniana, S. gibberulesum. S. prodii, S. Schickii, S. antipovichii, and many others. The percentage of success in distant crossings is sometimes so small that there is not sufficient material for selection and further selective work. Work done over a period of several years with wild species may, occasionally, in spite of thousands of performed crossings, not produce the desired results. Of much significance in potato selection is therefore the problem of overcoming non-crossability between wild and cultivated potato species. The most efficient method is the well known Michurin method of preliminary vegetative "rapprochement."

VEGETATIVE "RAPPROCHEMENT." Parent plants selected for crossing are first grafted onto each other. For instance, if one wishes to cross one of the frost-resistant species with some cultivated selective variety, the slip (cutting) from a wilding is grafted onto the cultivated plant or, on the contrary, the cutting of the cultivated variety grafted onto the wilding. When blooming period arrives the stock plant is crossed with the young shoot (graft) or vice versa. Grafted plants develop at each other's expense: the stock plant at the expense of the young shoot or vice versa, depending upon how the grafting was done and the direction in which either was trained. In building its body from nutrient substances produced by another component of the graft, these stock plants or scions change their

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basis by approaching one component in some characteristics; as a result of this they cross with greater ease.

Crossings are conducted within the limits of one grafted plant: the scion is pollinated with the pollen of the stock plant or the stock plant is pollinated with the pollen of the scion. Only in cases when there is no simultaneous blooming of stock plant and scion on one grafted plant, the pollen of another similarly grafted plant is used: the wild scion of the first grafted plant is pollinated with the pollen of the cultivated stock plant or that of another grafted plant, while the cultivated stock plant of the first plant is pollinated with the pollen of the wilding stock plant or the scion of the second grafted plant.

Several methods of grafting are known.

(1) TUBER GRAFTING, one of the widely used methods. The tubers are joined before planting in the ground. Tubers of two different parent plants are cut in half, vertically or horizontally, in such manner that the cut crosses an eye. One half of one parent plant is placed next to the half of the other parent plant and both halves are tied firmly together. The rest of the eyes are removed on both tuber halves. This operation is performed several days or even months prior to the planting of grafted tubers in the soil.

The other method involves the cutting out of a small piece of the flesh, including one eye from the tuber of the parent plant, representing the stock plant; the rest of the eyes are also removed and into this space an eye of the other parent plant (the scion's) is placed with another piece of its flesh. This eye is attached by tying it to the tuber-wilding, and

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this is planted in the soil several days or weeks later. The eye should preferably be taken out with a cylindrical corkscrew.

The shoot from the grafted eye nourishes during the first stages of its growth at the expense of the stock plant. To increase the influence of the latter upon the eye of the scion plant, it is necessary to leave the smallest possible piece of tuber flesh next to the eye.

Despite the relative simplicity of this grafting method, it may not be considered altogether convenient for purposes of preliminary vegetative "rapprochement." By using this method coalescence occurs in the soil and may not be constantly observed by the selector. In addition, stems may develop from additional buds where eyes were removed; the stems that develop from deep additional buds are frequently strongly changed, as compared with stems developed from ordinary eyes. These changes have nothing in common with grafting and may only confuse the selector.

The potato shoots appearing on grafted halves also produce early rootlets and transfer to a nutrition of their own; as a result the influence of the second component is reflected in a reduced degree. Aside from that, both components, the stock plant as well as the scion, are of the same age in this method and it is not possible to produce a predominating influence of one component upon the other. Because of all these considerations the grafting of potatoes by stem method is more suitable for preliminary vegetative "rapprochement."

(2) GRAFTING BY WEDGE METHOD IN SEGMENTS. The most widespread method of stem grafting is grafting by "wedge in segments." During this method the stock plant has its top cut off and all side runners removed. It is left with only

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one or two of the first lower leaves; the stem remaining left after the tip is cut off, is then slit along the stem surface to a length of 1.5 - 2 cm.

The plant designated as a scion has also the upper part of its stem cut off, 3-4 cm. long, and the cut end is sharpened on both sides in wedge shape, the length of the wedge made to correspond the length of the slit on the stock plant. This wedge is then placed into the segment of the stock plant and the graft spot firmly but not too tightly tied with a strip of gauze or bast string; the grafted plant is then placed either in a humid room or a cold frame, of which the glass is painted with chalk or lime to prevent the plants from wilting in the sun. The scion is left with a minimum of leaves (one or two) to reduce its capacity for evaporation and prevent it from wilting.

Some operators prefer to cover the cuts with a moist bandage of gauze or cotton rather than place the grafted plants into a moist room (chamber). But this method is not practical because the moist bandage causes decay of the cuts in some plants and the majority of the grafted plants are destroyed.

(3) GRAFTING BY TEST-TUBE. The above method, applied when grafting, is performed on plants grown in pots, in covered ground, wherever there is an opportunity to provide a moist atmosphere for the grafted plant. If the potato grows in the ground, however, it is preferable to apply the test-tube method. In that case the upper part of potato plants used as stock plants is cut off and the remaining stem sharpened on both sides in wedge shape. The runners are all removed to prevent them from absorbing

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nutrient substances. Slips of 7-8 cm. in length are cut from the scion plants and all leaves are removed from it also, except for the youngest leaf at the top. 4-5 cm. away from the cut end a slant cut of 1-1/2 to 2 cm. in length is made on the stem of the scion (to correspond to the length of the wedge of the stock plant; the scion is then placed with this slit into the wedge of the stock plant and the spot firmly tied with a bast (string) or gauze strip. The tip of the scion which remained free is dipped into a test tube filled with water and the tube is tied to the plant (Illus., p. 22).

Some operators do not remove the top of the stock plant but make a similar slanting incision on the stem, away from the top, as was done on the scion. In that case the skin is taken off on the wedges of both scion and stock plant and the wedge of the scion is entered into the wedge of the wilding. We do not recommend this method because all nutrient substances of the stock plant are in this case directed towards the tip of the plant's growth, and while the wilding grows rapidly, the scion receives only an insignificant amount of nutrient substances and coalescence proceeds slowly. Such grafting never produces a strong, healthy plant.

The grafting operation should be best performed in the evening, because during a hot day the young scion may immediately wilt and thus interfere with any coalescence.

Two or three weeks after grafting, the test tube is removed and the end of the scion cut at the place of coalescence. As already indicated, the method is adapted for work with plants grown in the field. It has,

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however, many disadvantages. The slip of the scion left in water in the test tube continues to be nourished by water and does not transfer to the nourishment provided by the stock plant; coalescence also proceeds much slower; the scion becomes exhausted and is not able to produce a healthy good plant. A healthy condition of both components is, however, the first assurance of success. Aside from that, coalescence is not complete in this method and occurs frequently only in spots on different places of the cut (slit) which interferes later with the full exchange between stock plant and scion.

Occasionally grafting is performed under field conditions with the common method of "wedge in segment," while the scion is covered with a parchment isolator (hood) to reduce water evaporation and prevent wilting. This method, on the whole, is not successful.

(4) GRAFTING WITH SEEDS. Some experimentors (S. A. Arkhangelskii of the Ulianovsk Potato Station) practice grafting with germinated seeds into the eye, rather into the sprout of the potato tuber. The sprout of the germinated tuber is cut off, a slit made on the stem and into this slit a scratched (scraped) rootlet of the germinated seed is placed. The tuber is next placed in a pot in such position that its upper part where the seed is grafted, remains outside. The tuber is covered from above with a glass vessel or can, to protect the seed at this stage from drying out. Coalescence occurs very rapidly. The young shoot which developed from the seed is exposed to a maximum of influence of the stock plant tuber because of the considerable difference in age between them. A small plant

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develops from the seed which is nourished during the first most important moments of its life completely at the expense of the stock plant tuber.

(3) GRAFTING BY SEGMENTATION WITH A TONGUE is the best grafting method we used over a period of years and which produced 100 per cent viability among all grafted plants, ensuring at the same time the widest influence of one component upon the other in a desired direction.

The planting of wild species of seeds intended for grafting is done in boxes at the nursery not later than by the end of March. Shoots appear two weeks later which are transplanted into pots. Seedlings of wild species are to be preferred for grafting because their tissues are younger (in stage) than the tissues of stems grown from tubers and they succumb easier to the influence of cultivated stock plants and scions.

Tubers of cultivated varieties are simultaneously planted into boxes. Earlies are preferably chosen for the purpose, as indicated above.

In crossings with wild frost-resistant Acaulia species cultivated varieties should be of the fertile kind because wildings cannot be utilized as pollinators. When the sprouts (shoots) of cultivated varieties appear, cuttings are taken from them which are transplanted into pots because in grafting a many-stemmed clump is cumbersome and it is desirable to have one stem preferably separated from the mother tuber.

Cultivated varieties may be sowed with seeds. In reverse grafting, i.e., when wild species serve as stock plants, it is easier to graft seedlings of cultivated varieties onto them rather than the cuttings grown from

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tubers. In this case the sowing of seeds of cultivated varieties is done somewhat earlier than is the planting of seeds of wildings (1-2 weeks). In utilizing the seedlings of cultivated plants it is essential to consider that these seedlings do not repeat fully the parent variety and frequently differ from it in all characteristics. It is therefore imperative to grow for control purposes every seedling from which a cutting of the scion has been taken. Despite the variegation of seedling offsprings of cultivated varieties, the cropping capacity of these seedlings is generally close to that of Solanum tuberosum and consequently exceeds radically the cropping capacity (yield) of wildings. Their utilization for inter-species graftings serve the purpose of providing the wildings with the cropping capacity of cultivated plants, and this aim is fully achieved. The advantage seedlings have over plants grown from tubers consists also in the ease in which they coalesce and their healthier condition. Tuber plants may occasionally be degenerated in hidden form.

At the end of April or early May one may begin the grafting of wild potato species to cultivated varieties and vice versa. The cultivated varieties are by that time vigorous and well developed plants, while the wildings are weak shoots bearing 2-3, occasionally 4 leaflets. This difference in the development of the respective plants serves to give predominance to the influence cultivated plants bear upon wildings.

It is to be noted that plants chosen for grafting should be healthy and strong and that their shoots should be periodically fed with weak solutions of mineral salts. It is best to use for this purpose 2 grams of potassium nitrate to one liter of water. The shoots are infrequently fed with a weak solution of manure (1:20). This feeding may be given once every 2-3 days.

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The upper part of the stem is cut off the stock plant 1 cm. above the second node, while from the lower part all/runners (pazushnye) are removed to prevent the draining from them of nutrient substances. The upper cut part of the stock plant is rooted to the scion for control. The stump of the stock plant is split along the stem 1.5-2 cm. with the blade of a disinfected safety razor and one of the split halves is sharpened wedge-like (Illus. 2, p. 25).

The tip of the stem, 2-3 cm. in length, is cut off from the plant intended as a scion 1 cm. below the lower node of the cutting's top (the lower part of the scion is reserved for control). Similar slits are cut on the cutting of the scion, as done on the stock plant, so that in addition to the sharpened wedge which is entered into the slit of the stock plant, the scion also has a "tongue" which is joined to the cut side surface of the stem of the stock plant. The wedge of the stock plant enters between the "tongue" and the wedge of the scion (Illus. 3, p. 26). The place of grafting is then firmly but not very tightly bound with a clean strip of dry gauze and the grafted plant placed in a moist chamber.

One or two leaves are left on the stock plant. It is not advisable to cut the stock plant in such manner as to leave a stump without leaves, because in that case the circulation of substances is interfered with in the stock plant and the latter may perish. The slits on stock plant and scion are preferably made into the leaf mark (trace) ("sled"), since there are a large number of vessels here and the circulation of substances from leaf to leaf is intensified. Because of the presence of the large amount of nutrient substances, coalescence takes place more rapidly.

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A minimum of leaves is left on the scion at the time of grafting, best of all one, the smallest, just unfolding leaf. This will protect the scion from unnecessary evaporation and wilting. The same aim is pursued by placing the graft into a moist chamber. Such moist chamber may be arranged under a frame (rack, stand) in the nursery. Its walls are lined all around with two layers of gauze; a layer of moss sphagnum (15-20 cm.thick) is placed underneath, which is well watered. The gauze is also kept constantly moist.

While the plants are in the moist chamber they are not watered, to prevent water from getting into the slits causing decay. If the pots dry out, the soil alone is watered without touching the stem. Here the plants remain one week. They are then transferred under a frame where moisture is considerably lower but where the plants are, nevertheless, protected from direct sunrays. In 10 days the plants are placed outside the frame. They usually have achieved some growth by that time and the bandage is removed. In another few days the grafted plants are transplanted into the open ground. The described grafting method ensures the best coalescence of stock plants and scion. Coalescence may be so close that by fall it may be difficult to locate the spot where grafting had taken place.

(6) GRAFT BY "VSTAVKA." To increase the influence of any of the components in a grafted plant one may make the graft by the "vstavka" method. The grafting is performed by the method described above, but when coalescence takes place and the scion starts to grow a slip of the stock plant is once more grafted onto it in the same manner. "Vstavka" is called the small section of the stem of the initial graft which is now included between

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two parts of the stock. Following the second grafting operation the plant is again placed into a moist chamber and the entire process of coalescence and care of graft continued in the usual manner.

"Vstavka" should have no less than two nodes, i.e., it should be a slip (cut) of the stem on which there are two leaves. This small cutting of the stem of the "vstavka" will experience a double influence from the other component, from its root system, as well as from the foliage surface. The stream of nutrient substances, both downward and upward going, derived from the stock plant, passes through the "vstavka" (Illus. 4, p. 28).

THE DEVELOPMENT OF GRAFTED PLANTS. The grafted plants are transplanted into open ground when the danger of early frosts has passed (in Leningrad by the end of May or beginning of June). After transplanting and when a certain amount of growth shows, the side runners (1-2) are left on the stock plant in order to provide flowers for crossings. To strengthen the influence of cultivated varieties upon wildings, the leaves from the latter and the scions are removed before buds appear. Care has to be exercised not to injure the axil leafbuds from which cymes will develop. Once the buds have appeared leaves are no longer removed for fear of causing buds to drop.

The wildings and wild scions show, nevertheless, a partial drying of the peduncle, while in the control plants of such fertile wildings as acaulis or demissum, every flower produces a berry.

As soon as the grafted plants begin to grow they soon develop some peculiar characteristics compared to control plants. In our work in transplanting grafted plants into open ground it was discovered that in the

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group where the wild species Solanum gibberulesum, S. parodii and S. schickii were utilized as stock plants, all species without exception produced tubers 20-25 days after grafting under the influence of cultivated scion varieties. The control plants did not show any tubers but only produced long stolons (Illus. 5, 6 and 7, p. 30). In order to prove that the reaction of the cultivated scion varieties had been exercised here and not the effect of the grafting operation itself, slips from other specimens of the same wildings were grafted onto some control wildings. Tubers developed only late in the fall as a result of these graftings.

Wild stock plants and scions subsequently reached highest development in the group of graftings where the enumerated species of the Commersoniana group were used as stock plants and scions. They seemed to suppress the cultivated varieties and exceeded control plants of the same species in development of foliage 1.5 to 2 times, reaching a height of 2 m. Fertility was at the same time considerably reduced.

Grafted plants, where wild frost-resistant species of the Acaulia group - S. schreiterii, S. punae and S. depexum were taken as stock plants and scions, developed somewhat differently. When transplanted into the ground the wilding-stock plants did not have any tubers yet, whereas in the fall these developed in large numbers. Every clump produced 100-200 grams of tubers, while the control ungrafted plants, within the same period (September), did not show any. On the contrary, stock plants of some cultivated varieties, especially those grown from the seeds of Epron, Ballydoon, Katahdin did not grow tubers under the influence of wild stock plants but instead produced growing stolons, as with wildings (Illus. 8,

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p. 32). All earlies to which wildings had been grafted showed considerable belatedness in tuber development compared to non-grafted clumps.

The wild scions, as well as runners of wild stock plants showed, when grafted, lengthier internodes compared to control plants. Some graftings of the Acaulia group differed radically in their development from controls and resembled in their appearance the first sexual generation obtained from crossings of these frost-resistant species with cultivated plants.

Seeds obtained from self-pollination of grafted plants S. Schreiterii, S. punae and S. depoxum were one and a half times as large as the seeds obtained from self-pollinated control plants of the same species.

As soon as the graftings bloom, usually in June, crossing of wild species with cultivated varieties begins. Our experience in pollinating cultivated stock plants and scions with the pollen of frost-resistant species of the Acaulia group, grafted onto cultivated varieties, showed that not one berry was produced. The reason for this is found in the external peculiarities of the flowers of Solanum tuberosum and the above wild species, i.e., styles of the flowers of S. tuberosum are approximately 1.5 to 2 times longer than those of flowers of the Acaulia group. Pollen tubes are consequently shorter in the Acaulia than in the tuberosum and the pollen of these wildings, after germinating on the stigma of the cultivated variety, does not reach the ovule, thus preventing fertilization.

To verify the above the following experiment was performed. Cultivated varieties having mature, ready to open buds were emasculated, the styles then cut (slit) through two-thirds of their thickness at about the center, bent and the Acaulia pollen placed upon the cut. The styles were then made

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to resume their former erect position and the cyme was covered with an "isolator." From among one hundred flowers pollinated in this manner only two produced berries. The percentage of success may, undoubtedly, be large since this method requires further exploring. It seems that many injured styles dry out before the pollen is able to germinate. It is to be noted that even these two berries appeared only on grafted plants and that the control plants did not produce any, which is understandable since the shortening of the style itself is unable to stimulate crossing.

RESULTS OF VEGETATIVE RAPPROCHEMENT. Vegetative rapprochement in potatoes, i.e., the pollination of wildings and scions with the pollen of cultivated plants, also taken from graftings, produces very good results. Components for crossing are if possible taken from one grafted plant, i.e., the flowers of a wild stock plant are pollinated with the pollen of the cultivated scion of the same grafted plant, or the flowers of the wild scion are pollinated with the pollen of a cultivated stock plant. Only in the absence of simultaneous blooming of the stock plant and scion, the flowers of another plant or similar grafted plant are utilized. We obtained in our experiments the following results from the crossing of frost-resistant species with selected varieties, by applying a preliminary vegetative rapprochement.

As a result of the pollination of the flowers of the species S. schreiterii, grafted onto cultivated varieties by the pollen of these cultivated stock plants, 75 per cent of all pollinated flowers produced berries. In a reverse distribution of the grafted components, i.e., when flowers of the same species, used in the capacity of stock plants for cultivated varieties, were pollinated with the pollen of cultivated scions, 75 per cent of all pollinated flowers also produced berries. At the same time, numerous control crossings failed to produce even one berry.

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All berries obtained from crossings by vegetative rapprochement bear one to six seeds. The berries of self-pollinated control plants had 300-400 seeds in each berry. Berries from crossings produced in the beginning of the vegetative period (June) bear 4-6 seeds, while berries of fall crossings had only 1 to 2 seeds. In the vegetative rapprochement of other frost-resistant species of the same Acaulia group numerically close results were obtained. S. punae showed successful crossing in 70 per cent; S. depexum - 63 per cent.

Wild potatoes of another group Commersoniana, resistant to the Colorado beetle, produced a somewhat lower percentage. S. gibberulesum 53 per cent, S. parodii 36 per cent, S. schickii 46 per cent. None of the control crossings were fertilized.

Pollen for pollinating wild stock plants and scions were taken only from graftings and not freely grown clumps, i.e., vegetative rapprochement was two-fold.

11 PRELIMINARY TRAINING OF CROSSED PAIRS. Another extremely effective method for overcoming non-crossability is preliminary training of both parents on the same stock plants. This method was first applied by us in 1948. Our stock plants were mature, already blooming tomato plants (var. Bizon). To some of these were grafted young seedlings of wild species, to others seedlings of cultivated potato varieties. The leaves from the scions were removed prior to budding so that they developed exclusively at the expense of nutrients provided by the tomato plant. During the blooming period the wild scions (S. punae, S. gibberulezum and S. schickii were crossed with cultivated varieties grafted onto tomatoes. In some instances the success from

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crossings amounted to 100 per cent (Illus. 9, 10, p. 35, 36).

Because of the distant relationship of the parents and the considerable difference in age between the tomato stock plants and the potato-scions, a predominating influence of the tomato upon the potato was achieved. The tomato shatters the hereditary basis of cultivated varieties, as it does in the case of wild species, as a result of which selectivity to conditions of external environment is reduced, specifically selectivity in fertilization. Inter-species crossings are therefore relatively successful.

Stock plants may be species of the same genus, though may belong to other species of the genus Solanum, to which wild and cultivated potato species included in the systematic Tuberarium group belong. It is true that the volume of the Tuberarium group (section) is tentative. We consider that species not having stolons and not forming tubers, and therefore called Etuberosa (?) should be excluded from the actual group of potatoes, i. e., the Tuberarium group. The Etuberosa are nevertheless phylo-genetically closest to potatoes. All remaining species of the genus Solanum, such as the nightshades: S. dulcamara (bitter-sweet), S. nigrum, and hundreds of other less known species are far more distant from potatoes. Professor S. V. Iuzepchuk, the famous potato systematician, considers the entire Solanum genus artificial and contends it should be divided into several genera, of which one should become a new potato genus, the Tuberarium.

It is possible that the wide series of inter-species graftings will pave the way to the division of Solanum. It really seems that inter-species scions, such as potatoes grafted onto nightshades, should be more vigorous than inter-generic crossings, i.e., potatoes onto tomatoes, tobacco or peppers, etc. In

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practice, however, graftings of potatoes onto tomatoes rather than onto nightshades are done most frequently, since they are more vigorous, as shown on experiments performed in 1932 by E. B. Yurkov at the All-Union Institute of Plant Industry and N. A. Lebedeva at the Petrodvorets in 1941. Even graftings of potatoes to the closest species of Etuberosa showed a weaker development than to tomatoes. On stock plants, Datura ("durman") and Belladonna which, like the tomato, belong to other genera of the nightshade family, potato scions developed less well than on tomatoes. The development is still weaker on peppers.

Formation of seeded berries in the case of potatoes was observed on the tomato stock plant, the black nightshade and Datura ("durman"). Other stock plants produced berries but they were frequently seedless.

The above data is tentative and does not preclude the possibility of obtaining better results. Actually, reverse graftings of Belladonna onto potatoes produce strong plants with abundant Belladonna foliage and potato tubers.

Similar plants are obtained from tobacco grafted onto potatoes (Illus. 11, p. 37). Petunia develops somewhat weaker on potatoes (N. A. Lebedeva). Inter-family graftings are also known, such as potatoes onto stock (Cruciferae), Campanula and Iresine Amaranthaceae.

POLLINATION WITH MIXED POLLEN. In order to overcome non-crossability, Michurin worked out a pollination method with mixed pollen which is equally usable for potatoes. For pollinating wild species of the Acaulia group by the cultivated varieties a pollen mixture is prepared of the most fertile

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cultivated varieties, such as: Katahdin, Earlaine, Ballydoon, Cobbler, Shgerkeragis, the hybrid Kemerar I, etc. The pollen of all varieties is taken in equal quantities. After a careful mixing the pollen mixture is placed in a thin glass tube corked at one end. To ensure the uniformity of the mixture it is advisable not to shake the pollen from all flowers of one variety at once, but to take one flower of each variety, then in the same order one flower at a time of the same varieties, etc. The potato pollen preserves its viability for seven days. But when contained in the thin glass tube it may be asphyxiated and lose its viability. It is therefore advisable to use the prepared mixture the same day.

The pollen is shaken from the glass tube upon the stigma of emasculated buds of wildings from a distance of 2-3 mm. above the stigma. We wish to repeat again that touching the stigma with either the glass tube or forceps or any other instrument is to be absolutely avoided, because this severely reduces the percentage of crossability by contributing to the breaking of the base of the style.

Our work in pollinating frost-resistant species of Acaulia with a pollen mixture of cultivated varieties resulted in over 40 per cent of all pollinated flowers producing berries. In pollinating the wild Commersoniana species, resistant to the Colorado beetle, with the pollen mixture of cultivated varieties we obtained 20 per cent of fertilized berries from all pollinated flowers. Control crossings of wild species were conducted with the same six varieties from the flowers of which the pollen mixture had been prepared, only each variety was taken separately. Numerous control crossings failed to produce a single berry.

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Despite the fairly high percentage of success and the comparative ease in applying this method to overcome non-crossability, it is to be noted that the percentage of successful crossings is relative in this instance because of the extremely small number of seeds in berries, rarely exceeding 1-2 seeds.

The berries of potatoes frequently do not produce most "valuable" (?) ("polnotsennye") seeds and are only filled with capsules not containing germs. Better results are obtained in this respect from the method stressing the influence produced by stigmas of the paternal male plant.

IV

INFLUENCE OF MALE STIGMAS. I. V. Michurin wrote about this method as follows:

" .... occasionally ... inter-species or inter-genera crossings are unsuccessful and I then make use of a special method, i.e., immediately prior to fertilization I place a part of the stigma from the pistil of the male parent onto the pistil of the flower to be pollinated; this stimulates the activity of the pollen tubes on the alien genus (?) (chuzherodnii) of the female pistil and increases the results of distant crossings."

We applied this method to potatoes. One may place a piece of the male parent stigma along with its pollen onto the stigma of the female parent. The stigmas must be mature, which can be told from their shine and viscosity. One may crush the stigmas of the male parent and deposit the mixture ("kashitsa") together with the pollen in small amounts onto the stigma of the female plant. Another method is to crush the mass of male stigmas, gather the squeezed liquid into a pipette and deposit a drop of the liquid on the stigma of the female plant, along with the male pollen. The first two methods produce, however, better results than does the last.

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During the inter-species hybridization of potatoes the fertilization of berries by using this method seldom exceeded 10-15 per cent, but all berries carried seeds and their number amounted to from 5-6 in each berry.

Crossings in this method should be made only in the evening or in cloudy weather, because during the day the pieces of stigma or their mixture, as well as the liquid derived from the latter dry out quickly and the application has no effect. The best time for similar crossings is from 5 to 10 p.m.

COMPLEX METHOD. The success of crossings may be further increased if the methods are not applied separately but jointly. Thus in combining the influence through male parent stigma with preliminary vegetative rapprochement, one is able to obtain berries with a large number of seeds. If berries under the preliminary vegetative rapprochement produce an average of 3-4 seeds, they bear 20-30 seeds from the additional application of the male parent stigmas.

INTERMEDIARY METHOD. In utilizing the intermediary method a third species is introduced into crossing, which crosses equally well with cultivated plants and wild species, while the heredity of the intermediary also has its effect.

For crossings with frost-resistant species of the Acaulia group one may take the wild phytophthora-resistant potato species Solanum demissum, of which the foliage is also frost-resistant up to minus 3-4° Centigrade. S. demissum crosses easily with cultivated varieties and with slightly

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greater difficulty with species of the Acaulia group. Hybrids obtained from the crossing of Acaulia with S. demissum are crossed the following year with cultivated varieties.

Primitive cultivated species, such as S. kesselbrennerii, etc., may be used in the role of intermediary; they cross relatively easily with Acaulia, the species Commersoniana, resistant to the Colorado beetle, and cultivated varieties. Crossings of the frost-resistant Acaulia with S. kesselbrennerii produce a healthy, vigorous hybrid progeny which is usually fertile and occasionally sterile. Fertile hybrids easily cross with cultivated varieties.

INTER-GROUP HYBRIDIZATION. In order to "shatter" the hereditary foundation (origin) of wildings, one may arrange for crossings within groups, for instance the Acaulia or Commersoniana groups. For similar inter-group crossings in the Acaulia group the following combinations are possible:

Solanum	schreiterii	X S. punae
S.	"	X S. depexum
S.	punae	X S. schreiterii
S.	depexum	X S. punae, etc.

It is possible to make crossings of species of different groups, for instance, Acaulia with Commersoniana, of which both have difficulty in crossing with S. tuberosum. Hybrids obtained from all these crossings are crossed with cultivated varieties in the following year.

Preliminary crossings (in this method) shatter the hereditary foundation of wildings and the hybrid acquires reduced selectivity in fertilizing.

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The intermediary method and inter-group crossings were applied at the All-Union Institute of Plant Industry (G. M. Kovalenko) and gave good results in crossings of varieties with Acaulia.

In applying any method designed to overcome non-crossability, it is necessary to consider: 1. the fertility of the pollen; 2. the technique of crossing; 3. the conditions under which crossings take place. Any method may prove unsuccessful if either of the above conditions is not accorded due consideration. Before proceeding with crossing, the viability of the pollen of the male parent has to be verified. The pollen should for this purpose be examined under the microscope or germinated on an artificial medium. It is possible to check upon the pollen by applying inter-varietal or intra-varietal crossings. Directions on the technique of crossing were given above.

Isolation also commands much attention. In crossing with Acaulia species we applied a new type of isolation which in the majority of cases ensured the success of the crossing. The entire plant was isolated. The isolator is a wooden framework on sharpened legs, the side walls of which are covered with cellophane, while the upper wall is made of parchment, in order to provide the isolated plant with some shade.

The plant designated for crossing is prepared in the following manner: All opened flowers are removed, as well as all small buds, and only those buds are left which are about to open. Next all points of growth are removed on the plant because they carry some undeveloped buds which would open while the plants remains in the isolator and could pollinate the buds intended for crossing. The remaining mature buds are emasculated. If on

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any of them an open pollen sac ("pora") is found on the anther, the bud is eliminated, otherwise it would be exposed to self-pollination. The pollen of the male parent is deposited on the stigma of the emasculated buds and the cellophane isolator then placed over the plant; (this structure should be of such dimension as to allow free movement for the plant); the legs of the isolator are dug into the soil and the structure firmly set onto the soil surface. It is kept over the plant for 10-12 days, and then removed. A note is made concerning the number of fertilized berries, and the plant permitted to grow freely (Illus. 12, p. 43). Under the cellophane structure there is always moisture; the temperature is more or less uniform throughout the day and night compared to the outside temperature. In the early morning (5-6 a.m.) the temperature of the outside air begins to mount, while the temperature under the isolator falls behind the temperature of the outside air. At 10 a.m. the temperature under the isolator is 2-3 degrees below that of the temperature of the surrounding air. In the evening when the temperature of the outside air drops rapidly, it falls but very little under the isolator and is higher than the temperature of the surrounding air.

Increased moisture and more uniform daily variations in temperature create favorable conditions for the germination of the pollen on the stigmas of the plant. This was confirmed in our experiments by the increased fertilization of berries, compared to the ordinary parchment isolator placed upon the cyme of a plant.

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VEGETATIVE HYBRIDIZATION (p. 43-53)

It is possible to obtain a potato hybrid progeny without sexual crossing. Another powerful means for obtaining hybrids, used in selection, is vegetative hybridization, i.e., hybridization by (means of) grafting, which does not differ in principle from sexual hybridization. Lysenko writes about this as follows: " ...vegetative hybrids do not differ basically from hybrids obtained by sexual means. Any characteristic may be transmitted from one race to another by using grafting, as well as sexual methods."

Vegetative as well as sexual hybridization is accompanied by the "~~splitting~~" segregation (?) ("rashcheplenie") factor in the progeny which is of a somatic or vegetative nature; i.e., characteristics of both parent plants appear simultaneously on one specimen. Thus, grafting a blue-tuber potato variety onto a white-tuber variety will produce white, blue, and variegated tubers in the plant's progeny. Somatic ~~splitting~~ segregation, according to several authors (Prof. N. V. Turbin), occasionally takes place in sexual hybridization.

During vegetative and sexual hybridization, the factor of heterosis in the progeny is noted (increased strength and viability of hybrids) and the factor of the shattering of the heredity, as a result of which the progeny of vegetative hybrids has reduced selectivity for conditions of external environment.

Vegetative hybrids are produced as a result of changes, caused by grafting, in the nourishment of any component, i.e., change in metabolism. Vegetative hybrids may serve as material for the production of new varieties.

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Potatoes, along with other Solanaceae, have for a long time been a favorite object among many researchers for obtaining vegetative hybrids.

Charles Robert Darwin in his book (1868) "The Variation of Animals and Plants under Domestication" devotes an entire section to the problems of vegetative hybridization under the heading "Hybridization by Grafting," where he lists numerous factors known at the time for securing vegetative hybrids from potatoes. In referring to several examples he wrote: "...in grafting two potato varieties to each other it is possible to obtain hybrids.... Hybridization by grafting has its effect on a variety of characteristics, independently from the method of grafting itself; plants derived from this procedure produced tubers which combined exclusively the different parental characteristics with regard to general form (shape), coloring, the nature of the surface and the shape of eyes and, according to the testimony of two careful observers, even deeper inner qualities. Potatoes provide us with the safest proof of the possibility of hybridizing by graft..."

The famous Russian scientist K. A. Timiriazev was a staunch supporter of the Darwin theory on grafting hybrids. Without making any radical distinction between a simple heredity (vegetative propagation) and a complicated heredity (sexual propagation), Timiriazev considered that the production of hybrids represents the uniting link between simple and complex heredity.

Vegetative hybridization acquired wide recognition later in the works of the Soviet scientists I. V. Michurin, T. D. Lysenko and the latter's followers. A. A. Avakian grafted onto the red tuber variety "NAIKA" the

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white tuber varieties "ALMA" and "ELLA," and obtained a progeny of white tubers. In grafting the blue tuber variety ODENWALD blue onto the white tuber variety ELLA, he obtained colored and white tubers in the progeny, though with colored sprouts, while the sprouts of the ELLA variety were devoid of coloring. The intensity of the coloring of the eyes grew simultaneously with each generation. In the second generation pigmented stems appeared on some plants, a feature which ELLA never possessed, while in the third generation many plants had tubers with blue eyes and white and blue spots. On the basis of their experiments, Avakian and M. G. Iastreb reached the following conclusions:

1. Seed and vegetative progenies of grafted plants develop many hereditary characteristics belonging to the component of the grafted plant which acted in the capacity of mentor.
2. The conduct of the progeny of grafted plants shows that hybrids obtained through the vegetative method have many biological features equally possessed by sexual hybrids.
3. The obtaining of vegetative hybrids serves as a particular illustration of the effect the change in the hereditary nature of plants has on the specific character of their metabolism...

V. I. Razumov grafted slips of cultivated potato varieties onto wild species which formed tubers only during periods of short days and obtained from these species, through the influence of cultivated scions, tuber formation for periods of long days. In reverse graftings, i.e., when slips of wild potato species were grafted onto cultivated varieties, the cultivated

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stocks showed a strong tendency of delay in formation and growth of tubers, compared to control plants.

Numerous examples of changes in wild species (S. demissum and S. acaulia) are cited by A. S. Filippov following their grafting upon cultivated varieties.

F. S. Solodovnikov grafted slips of the variety ALMA onto S. demissum. The stock plant formed runners which were separated from the stocks and planted separately into pots. As these cuttings grew and developed, a different degree of changeability, favoring the cultivated scion, became apparent. One of the cuttings formed tubers 82 days in advance of the control (S. demissum). Tubers of the cuttings were also several times as large. Some were of elongated shape, as in the variety Alma. Three cuttings had each 48 chromosomes, as in the species S. tuberosum, to which the scion, the variety Alma, belonged. S. demissum has 72 chromosomes.

Analogous data was obtained in our own work at the experimental station VIR in the city of Pushkino (Leningrad oblast). Under the influence of cultivated scions all wild species of which the tubers formed only during short days, produced germinated tubers during long days. These tubers were 2-3 times as large as the tubers of control wildings grown during short days.

The greater the difference in age between the scion and stock, the stronger the influence one exerts upon the other. The young organism of seedlings is more flexible and easier to influence than the mature and already fully formed organism grown from tubers. In grafting wild species to cultivated varieties, and in order to strengthen the influence of the latter upon wildings, it is advisable to use cultivated varieties in tubers and wild species in seedlings because wildings possess a more conservative heritage and greater

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strength for transmitting this heritage than do cultivated varieties which are relatively younger in origin.

In obtaining vegetative hybrids the quantitative correlation between the assimilative leaf surface of scion and stock has equal significance. The component we desire to change in a specific direction should be left with a minimum of leaves, which should be cut as they unfold. If we wish to change the stock, all its leaves should be cut off after the graft has become fixed. The first side runners showing from axil buds should be also removed, because later runners will change in a large measure.

If the scion is to be changed, its top is replaced by grafting a slip taken from the stock. On the thus formed "vstavka" all leaves are removed. It is also necessary to remove at the beginning all leaves on the first appearing side runners of the "vstavka" (Illus. 4). Side runners on the "vstavka" are not to be removed since they have only two nodes, which may produce only two runners. If these are removed, the "vstavka" may not be able to produce any runner.

We made several graftings with sprouts of wild frost-resistant species onto cultivated varieties and observed considerable changes. Here is a brief description of these graftings.

On May 31 the two-week-old seedling of the wild frost-resistant potato species S. punae was grafted onto the three-week-old sprout of the variety Ballydoon, separated from its tuber. The stock (Ballydoon) had 5 leaves, the scion (S. punae) only 2, and only 2 cm. in size. It was cut along the cotyledon

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and its lower part was left for control. The grafting was done by the "cleft with tongue" method. When the components of the graft grew together and as the plant continued to grow, the leaves (prior to budding) were removed from the scion, while the stock plant was given every opportunity to develop freely and produce side runners. Soon afterwards changes were observed between scion and control. The former had elongated internodes (compared to the control) and larger, stronger, pinnated leaves. In subsequent growth these distinctions were still more accentuated, the scion producing an erect stem and reaching a height of 60 cm., while the control plants bore a typical for the Acaulia rosette and their height did not exceed 15 cm. from the ground.

Modification was observed not alone in vegetative but also in reproductive organs. Instead of flowers "sitting" on a shortened receptacle without apparent joints ("sochlenenia") on the peduncle (a characteristic of S. punae), the scion developed an inflorescence (cyme) having a receptacle of 10 cm. and clearly distinguishable joints on peduncles. The flowers of the scion were somewhat larger than those of the control, and none of them germinated berries from self-pollination, while in the control every flower produced a fertilized berry. The entire plant resembled in appearance the first sexual generation obtained from the crossing of Acaulia with cultivated varieties.(Illus. 13 and 14, p. 49). In examining the pollen of the scion under the microscope it was observed that the pollen grains possessed a somewhat thicker coat than the control. Similar changes took place in two other grafted plants; in one instance the two-week-old seedling S. punae was taken as stock and a three-week-old seedling of the variety Ballydoon was grafted to it; in the other case a two-week-old seedling S. schreiterii served as stock and a three-week-old

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seedling of the variety Katahdin was grafted onto it. Neither of the two stock plants produced leaves in six weeks, nor did they have side runners. Side runners which developed only in the second half of July (graftings were made May 31) resembled the first sexual generation from the crossings of frost-resistant species with cultivated varieties (Illus. 15, p. 50).

In examining the rootlets of these grafted and control plants, it appeared that the rootlets of the control S. punae had tightly joined six-cornered cells with one nucleus ("iadro"). Dividing cells have, as a rule, 48 chromosomes (Illus. 16, p. 51).

When S. punae was grafted onto the variety Ballydoon there was a marked difference in the number of chromosomes on the cuts of the rootlets of the scion; instead of 48 (control), there were 52-60, several cells having produced two nuclei. The cuts of the rootlets of the stock plant of the second grafted plant showed a mass of multi-nucleus cells, the number of nuclei in some cells amounting to 5. The number of chromosomes was 56 to 60 and higher (Illus. 17, p. 52).

These remarkable facts indicate that in S. punae, because of the different type of its metabolism produced by grafting, the chromosomal apparatus, along with the rest of the plant parts had been subjected to change. Consequently, it was not the chromosomal apparatus with its definite number and structure of chromosomes that had determined the entire type of growth and development of the plant, but the environment acting through the metabolism determines the external type of development of the organism, and also the development of its chromosomal apparatus. Vegetative hybridization

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opens wider perspectives for potato selection than does sexual hybridization, since it draws into selection all varieties, irrespective of whether they are fertile or sterile. It is known that the majority of early potato varieties are sterile, some of them don't even bloom and drop their buds, which makes it impossible to use them in selection. On the other hand, many varieties which are good pollinators are altogether unsuited because of their economic qualities.

In vegetative hybridization all early varieties may be used in selection, as well as the most valuable sterile medium and medium-late varieties. In addition, vegetative hybridization offers the opportunity of training sexual hybrids and changing their characteristics in the desired direction by grafting hybrids to any varieties.

TRAINING OF HYBRIDS (p. 53-54)

INFLUENCE OF EXTERNAL ENVIRONMENT

The work of selectors does not end with the production of hybrids. A hybrid represents an organism which includes the capacity of resembling either one of its parents. Whether any potentialities develop depends to a large extent upon the ability of the selector. As a rule those potentialities develop which find suitable conditions in their external environment. The rest remain "unpronounced" in the hybrid organism and in a hidden state. This is what Michurin wrote: "The influence of the entire aggregate of external factors upon the structure of the organism is generally so large that in the majority of cases it subordinates the reaction of the hereditary transmittance of qualities of the parental plants. Such influence is particularly

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apparent in the condition of the maternal plant during the time when the germs of the future hybrid organism are being "laid" (?) through the seed structure, and also on the resulting hybrid in its earliest stage of development, in favoring some and presenting an unsurmountable obstacle for the appearance of other hereditary traits..."

Consequently, those parental characteristics and qualities are developed in a hybrid for which favorable environmental conditions have existed during the early stage of its growth.

Under external surroundings are understood conditions pertaining to the composition of the soil, air and soil moisture, temperature of soil and air, degree of light, etc. Based on the above, one must condemn the practice of some selectors in overlooking the influence of external environments upon the formation of the heredity of the hybrid organism. Thus in obtaining hybrids of frost-resistant wild potato species with cultivated varieties and in growing them in nurseries, then transferring them into cold frames and transplanting them only in June into the soil, the selector involuntarily reduces the frost-resistance of his hybrids, since this characteristic does not find conditions necessary for its development in the external environment. All selection work should be conducted on a high agricultural level, our practice work demanding ever new varieties, capable of meeting high standards. Many Stakhanovtsii have fully adopted numerous agricultural practices which ensure high potato yields. At present our agriculture is in need of potato varieties which would meet the above agricultural methods. In order to produce a variety that is responsive to a high agricultural standard, it is necessary, however, to train a hybrid generation from the beginning on a similar level, in order that it may develop the demand for this standard in its hereditary foundation.

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MENTOR METHOD (p. 54-55)

In addition to creating certain environmental conditions, a powerful method of training hybrid progenies is the mentor method, proposed by I. V. Michurin.

"Whenever the hybrid seedling lacks endurance (hardiness) it is necessary to submit it to a repeated influence on the part of the parent which in crossing played the role of frost-resistance transmitter. Cuttings of seedlings are therefore grafted temporarily (for two or three years) onto the crown (?) of this parent, which in those cases serves as a necessary mentor for increasing resistance ... In the first years of the fruiting of a new variety I was able to correct some defects in the quality of fruits by using the mentor."

It follows that the mentor is a trainer. In the case of potatoes the mentor may be the variety upon which a hybrid seedling is grafted, or the one grafted onto the hybrid seedling, certain characteristics of which it is desired to transmit to the hybrid plant. If the resulting hybrid potato plant does not produce tubers for a long time, it is possible to speed up tuber formation by grafting early potato varieties onto the hybrid seedling.

It is similarly possible to change the undesirable coloring of tubers in potato hybrids. By grafting white tuber varieties onto blue and violet tuber hybrids, it is possible to produce a white tuber hybrid progeny. One may also change the shape of tubers and shape of eyes, as well as many other traits.

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To hybrid phytophthora-resistant seedlings, possessing good economic qualities but insufficiently resistant to phytophthora, it is necessary to graft wild phytophthora-resistant species to strengthen their resistance. The same may be done with regard to frost-resistance. In obtaining hybrids from crossings, resistant to the Colorado beetle, the selector should, for one thing, create plants with a valuable complex of economic qualities by training, and on the other hand, should train hybrid seedlings on wildings resistant to injuries inflicted by the Colorado beetle. It is known that many old varieties and wild species of potatoes change their heredity in grafting, and this influence is consequently greater when applied to young hybrid seedlings, considering that hybrids possess a shattered hereditary foundation.

CONTROLLING DOMINEERING QUALITIES (p. 55-57)

The problems of training hybrid seedlings in distant hybridization of potatoes are still insufficiently studied and little has been done in this direction until now.

We are in a position to present here only the tentative direction which future work concerning control over domination in hybrid potato progeny may take with regard to various characteristics.

Let us analyze it on an example of the product of frost-resistant hybrids obtained from the crossing of frost-resistant species with cultivated varieties. In the first place it is essential to establish which period in the life of frost-resistant species possesses greatest frost-resistance in

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order to appraise the possibilities for the development of this characteristic in the hybrid progeny. It is further necessary to establish the minimal temperature under which seeds of the species Acaulia germinate and the minimal temperatures under which their tubers grow. Only then is one able to train the heredity of a hybrid organism.

Hybrid seeds should be sowed at a somewhat lower temperature than that necessary for seeds of the Acaulia species. Small shoots at the 2-3 leaf stage are transplanted into open ground and not into a nursery or cold frame.

Transplanting takes place at definite periods; in Leningrad, beginning April 15, one part of the hybrids may be transplanted on that date, another 5 days later, the following another 5 days later, etc. This is done to protect the hybrid material in cases of severe late frosts. Under those conditions deviation in the development of hybrids is possible, such as their leaning completely towards wildings, not alone in frost-resistance but also in other characteristics, since frost-resistance is indirectly connected with other traits of the organism.

In order to offset this deviation special attention is directed to soil prepared for the transplanting of shoots. The soil has to possess maximum fertility, nutrient elements should be in a condition easily absorbed (accessible) by plants. It should best consist of 50 per cent humus. During subsequent growth and development of hybrids they should be periodically fed. Additional feeding should be differentiated; some seedlings should be given mineral fertilizers with a predominance of nitrogen, others

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predominantly potassium, the third - phosphorus, and the fourth provided with complete fertilizers. Nitrogen, as is known, reduces frost-resistance in the plants but contributes to the stronger growth of the vegetative mass of the plant. Potassium increases frost-resistance, while phosphorus aids the development of the reproductive plant organs.

Early varieties should be grafted in May onto part of the hybrids, leaving the other part ungrafted for control. Throughout the entire vegetative period every clump should be kept under close observation and the planting should consequently not be thick (close).

All clumps, both grafted and ungrafted, should be marked for their blooming period, tuber formation, etc. In the fall harvesting is done separately by clump and the yield of every clump determined. In the following year the tuber material is transplanted at lower temperatures than those of tubers of the wild species Acaulia. Only tubers of the best clumps are planted.

Plants grown from tubers are grafted once more to early cultivated varieties. It is possible that repeated crossings with cultivated varieties may be required in order to obtain a shattered hybrid progeny again and to direct the training of the heredity of the hybrid progeny.

SELECTION (p. 57-58)

Of essential moment is the work of selection. Considering that there are no two identical organisms in nature, we shall never be able to obtain from crossing a completely one-racial (?) progeny with an identical combination of all its characteristics.

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I. V. Michurin states: "... All results from the crossing of the same parental pair never repeat themselves, i.e., if we cross two plants and obtain hybrids with a combination of certain characteristics, we shall, nevertheless, never obtain the same structure of hybrids, no matter how many times we may repeat crossings within this pair of plants.

"Even seeds from the same fruit obtained from crossing produce seedlings altogether different from each other. Nature, it seems, in creating new forms of live organisms provides an endless variety and never permits repetition..."

And further: "The experimentor should attempt to prepare in advance by hybridization and individual selection if not hundreds of thousands, at least tens of seedlings of an approximately desirable structure of organisms, improve them by efficient training and make their largest number valuable and useful for man's use."

A selector by using individual selection should choose the best potato plants with the most desirable combination of economically valuable characteristics. The evaluation of seedlings with regard to these most valuable combinations of characteristics should precede the selection among hybrid seedlings of plants possessing the best combination of economically important traits. This evaluation should preferably be made in the first vegetative period. Beginning with the first stages of the seedlings growth, it is therefore necessary to conduct the most careful observation over them. The blooming period of seedlings requires considerable attention since early and short blooming in potatoes is usually an indication of earliness. It

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is further important to note the beginning of tuber formation in seedlings and the intensity of the tubers' growth.

During the first harvesting period all clumps with deformed and diseased tubers, those with long stolons, clumps with very insignificant tuber yield, clumps with a poor tuber shape and deep eyes, as well as tubers with dark colored tubers should be rejected.

In selecting for phythophthora resistance all clumps infected by that disease are rejected in the first year. In selecting for frost-resistance a natural rejection of plants of insufficient frost-resistance takes place at early transplanting.

REPEATED CROSSINGS (p. 58-59)

Occasionally, in spite of selection and training, many wild characteristics continue to dominate in hybrid plants, i.e., spread cluster, small tubers, inadequate tuber yield per cluster, etc., which is explained by the strong hereditary transmitting power of wild species, as compared to the younger in origin cultivated varieties. With each year the influence of directed training gets less significant, since we already deal not with seedlings but tuber material, of which the tissues are older in their stages and more difficult to influence. It is, however, inadvisable to use a second seed generation which is always poorer in quality than the first, a circumstance supported with regard to potatoes by the entire experimental experience of VIR.

In such case it is necessary to use repeated crossings of hybrid plants with cultivated varieties. Michurin writes: "First in importance in producing

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new varieties of fruit plants is the third method, the method of repeated crossing with best cultivated and foreign varieties."

Michurin advocates the use of the hybrid plant as the maternal parent. During repeated crossing the hybrid, as a comparatively much younger plant than the cultivated variety, does not produce a one-sided transmittance of hereditary characteristics in the progeny. A hybrid progeny obtained from repeated crossings is again subjected to directed training and segregation.

PRESERVATION AND IMPROVEMENT OF POTATO VARIETIES (p. 59-60)

The work of producing potato varieties does not end in selecting a specimen produced by hybridization, clonal selection, etc., and trained in the necessary direction. In the course of its further existence the variety is steadily subjected to changes from environmental conditions. Some of these changes are not apparent on the surface since they concern yield, early ripening (maturing), etc., while the appearance of the variety remains approximately the same. In other instances the appearance of the variety is somewhat changed, but only in certain characteristics, for example, the vigor of the clump, the nature of bloom, etc. Finally, the most widely distributed changes among potatoes are known as degeneration. In potato selection there are two categories of degeneration. In some cases degenerated plants may appear as a result of inter-species hybridization; among them, for instance, chlorotic, low growing, deformed plants, frequently observed in plantings of seedlings during the first year. In other cases degeneration is the result of improper growing of seed potatoes. These cases are particularly frequent in selection and seed growing practice.

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Lysenko tells concerning this: "Potato plants are sensitive to conditions of growth with regard to changes in their varietal race. This is important to consider in order not only to prevent deterioration of varietal potato material, but to improve it from year to year, observing and selecting the best conditions for seed potato growth." "The conditions in an external environment leading to the satisfactory development of different plant organs, such as potato tubers, improve equally the race of plants in the same direction."

In order to prevent degeneration it is necessary to create satisfactory conditions in nutrition by the proper selection of an adequate field under grass crop rotation, a soil of good structure, proper fertilizing and cultivation.

In studying the problem of summer plantings, Lysenko pays attention to the circumstance that growing potatoes at definite periods and on soils where "...new tubers are formed under cooler fall conditions, not only preserves tubers from degeneration but also changes the potato race...in the direction of providing it with greater vigor." This statement of Lysenko's should equally be taken into consideration.

Cool soil conditions during the period of tuber formation are created in two ways, by 1. summer plantings, 2. planting on turf (peaty) soils.

SOILS FOR SEED POTATOES (p. 61)

Peaty soils are colder than are argillaceous and sandy soils. According to Holzberg (VIR Dept. of Agro-Meteorology), the difference in the temperature of Leningrad soils in the middle of May, at a depth of 5 - 10 cm., varies between 4.8 to 5.6 degrees.

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Temperature conditions of peaty soils are not the sole factors in improving seed potatoes. Good structure represents one of the positive qualities of peaty soils. In the absence of peaty soils for seed potato planting, soils of the best structure should be allotted. Specifically, sandy and super-sandy soils under good cultivation and an adequate supply of moisture are better suited for seed potatoes than dusty and non-structural heavy soils. The acidity of peaty soils controls the development of scab and thereby raises the quality of seed potatoes.

Peaty soils are found in more humid locations and it is therefore advisable to choose well drained plots, particularly for early plantings. Soils that are too acid should be limed. Spring transplanting is done on ridges.

FERTILIZING OF SEED PLOTS (p. 61-62)

In fertilizing seed plots it is not permissible to allow for a one-sided increase of nitrogenous fertilizers which increases susceptibility to disease and contributes to potato degeneration. The increased introduction of potassium fertilizers is essential since they provide for resistance to disease and degeneration. The best potassium fertilizers are ashes. Lack of potassium on peaty and virgin soils causes leaf bronze and premature wilting of the foliage, while one-sided potassium fertilizing, as any other kind, may reduce the seed qualities of potatoes. High natural fertility of the soil and complete (full) organic fertilizing create best conditions for seed potatoes.

Complete organic fertilizing has many advantages over "complete" mineral fertilizing, into the content of which enter usually only nitrogen,

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phosphorus and potassium salts. Manure, as do ashes, contains other nutrient micro-elements. Ashes of the potato itself are of particular interest in this connection for the study of the significance of separate composite parts of nutrition in controlling degeneration of potato varieties (according to research done by the academician I. G. Eichfeld.)

PROVISION OF MOISTURE FOR SEED POTATOES (p. 62-63)

Of great significance is the provision of potatoes with moisture. Abundant rains may create a lack of nitrogen and other nutrient elements (substances), such as magnesium and potassium which are easily washed out of the soil. The proper supply of water to growing tubers may occur during a period of drought, and be particularly severe on heavy "raw, moist" soils which do not only give up their moisture with more difficulty to the plant but even withdraw it from the tubers in some cases. This is called "salting of tubers," caused by the increase of potassium salts in the tuber, and may lead to potato degeneration.

As a rule, seed qualities of potato varieties are determined not only by the presence of adequate nutrition and moisture but the proper, regular course of their introduction to the plant.

If needed friability may not be obtained for creating necessary moisture on potato seed fields, following even brief drought periods, irrigation is necessary. This is imperative not only for increasing yield but primarily as a means of sustaining good seed qualities of potato varieties.

During abundant rainfall additional feeding of potatoes with ashes, organic and other fertilizers, is required depending upon the appearance of the lack of any composite part in nutrition.

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In similar manner good soil structure and friability are of advantage to potatoes if they provide an adequate airing of the soil not interfered with by high levels of ground waters or drowning through an abundance of rain. In the latter cases an over-supply of moisture causes potato degeneration in even peaty soils. This may be prevented by draining such soils.

WEED CONTROL (p. 63)

Weeds should be completely eliminated on seed potato plots. Many weeds represent sources of disease infection for potatoes, even if they are not present in the immediate vicinity of the field but are found at a distance of hundreds or even thousands of meters away. Weeds are therefore destroyed not alone on potato seed plots but also within a radius of hundreds and more meters from them.

Isolation from other vegetation is equally essential if the latter is threatened with aphids and other insects which directly or indirectly may cause injury to potatoes.

SUMMER PLANTINGS (p. 63-64)

The theory of summer plantings of potatoes was created for southern conditions but their significance is, no doubt, a great deal wider. Lysenko states: "It is imperative to change immediately the method of growing seed potatoes in the central belt of the Union, by productive experiments, improving the race by way of the above agricultural technique (summer sowings) from year to year.

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The compelling necessity for summer sowings, not alone in the south but in the central belt of the USSR, is caused by the fact that conditions constantly affecting the degeneration of potatoes in the south are periodically found in the central belt. As indicated by Lysenko, "...even at a limited 'opening' (?) of the eyes (buds) of potato tubers the nature (heredity?) of the cells of these eyes is changed for the worse with regard to yield, under the influence of high temperature." The opening of eyes and growing of tubers under the clump is not infrequent also in the Leningrad oblast. "The improvement of the nature of plants by good agricultural methods and satisfactory conditions of nutrition may be clearly demonstrated on the example of summer plantings of potatoes in the south."

"Conditions are created during summer plantings under which tubers of a size of 300-500 grams are obtained. This testifies to the fact that satisfactory conditions are created during summer sowings for the development of tubers. It also explains the steady improvement of potato races from generation to generation."

The increase of yield from year to year is accompanied by the increased size of the maximal tuber weight, "from 300-500 g. to 1000 - 1470 g" and even 2 kg." In the Leningrad oblast summer plantings have repeatedly been tested by VIR. It was discovered that harvesting of summer plantings should take place as late as possible to prevent the reduction in yield of late varieties especially/for those which summer planting is not required. A precise and careful observance of the following demands laid down by Lysenko for drought conditions during summer plantings is also essential:

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"In order to secure potato yields by sowings made in late June to the middle of July, it is necessary to use a deeply plowed plot to keep this plot from early spring up to planting time in a state of best black fallow, i.e., free from weeds and under a friable, mulched surface layer. Under these conditions the supply of winter-spring moisture is well preserved. Simultaneously, towards the middle of the summer these plots accumulate a large quantity of dissolved nutrient substances (elements), as shown by a multitude of data provided by our experiment stations; of nitrogen nutrient, nitrates alone, 50 to 60 poods per hectare were accumulated."

CONTROL OF PHYTOPHTHORA (p. 64-65)

The application of summer plantings in the central belt of the USSR and the Leningrad oblast may cause (produce) arguments concerning the great damage caused by the phytophthora disease. During summer planting, potatoes are younger at the time phytophthora appears and therefore less susceptible to it. In addition, all other methods should be applied to control phytophthora. These include crop rotation which excludes predecessors carrying sources of infection, such as tomatoes, not to mention those from potatoes to potatoes. Plants from plots infected by phytophthora in the preceding year may also serve as a source of infection, even in the absence of tuber disease, since the infection may be transmitted mechanically from the skin surface. In order to eliminate this source of infection it is necessary to treat seed potatoes with mordants. This will eliminate the infection and other potato diseases such as rhizoctonia. Among other preventive methods are high hilling, spraying with Bordeaux mixture, compulsory cutting of the

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foliage prior to harvesting. All these methods should be observed with particular care during summer plantings. The problem of isolating by distance for the purpose of offering protection from phytophthora has not been sufficiently studied and may carry significance only at a distance of some tens of kilometers which is practically impossible to achieve.

The danger of phytophthora infection during summer plantings is completely eliminated in growing phytophthora-resistant potato varieties for seed.

QUALITY OF SEED MATERIAL (p. 65-66)

The creation of the best (most favorable) conditions for growing potato varieties determines their racial seed qualities.

The qualities of future seed potatoes begin to show already in the field, from the start of germination and throughout the growth of potatoes. The task consists in observing the plant's traits that characterize its seed quality in time and in destroying degenerated poor specimens.

Degenerated and other diseased clumps are destroyed immediately following discovery, i.e., beginning the appearance of shoots. These clumps by fouling ("zasoriaa") the plot deprive healthy plants of nutrition and may in addition cause the infection of plants. Which then is the type of degenerated potato clump that must be destroyed?

All degenerated and depressed plants, of belated growth, as well as those affected by leaf curl and leaf roll are to be eliminated. Clumps affected by wrinkled and striped mosaic, mottling, etd. Mottling represents

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one of the most prevalent forms of degeneration. If cleaning is delayed, mottling may escape notice, since after the blooming period mottled plants cannot be told apart from normal plants.

The yield from mottled plants is reduced by 15 per cent and over. Since mottling changes into wrinkled mosaic, which is particularly harmful, the cleaning of mottled plants is compulsory from the stage of germination. It is best recognized in cloudy weather, if leaves are looked at through the light. Selection for varietal improvement is essential, by dividing the yield of a seed plot into two parts, the super-elite and the elite.

The separation of super-elite begins in the summer in the field as part of varietal improvement selection. The healthiest and most vigorous clumps on the plot are marked. There should be no trace of pale mottling on the foliage of young plants, or later, so long as pale mottling may be recognized before the appearance of brown mottling and brown spots caused by other diseases showing later (macrosporium, phytophthora, etc.)

In harvesting all marked superior clumps are dug up separately and the best clumps of tubers of highest yield and quality thus set apart. The quality of tubers in a clump determines its racial qualities whenever this may be established by the appearance of tubers. Racial qualities are poor if tubers are split because of degeneration, if they are deformed, i.e., if they deviate in shape from the normal shape characteristic for the particular variety. Deformed tubers may also have elongated tips, spiral-shaped and lengthier than normal tubers, possess outgrowths, etc. Similar tubers produce degenerated plants.

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In the process of selection for varietal improvement not only the individual misshapen tubers are rejected but the entire clump if in the latter a single deformed tuber is found.

Once rejection has taken place the entire yield of the best clumps is gathered as super-elite. The rest of healthy potato tubers compose the elite.

If in the field and in harvesting individual few clumps stand out particularly, they are gathered and stored separately. The planting of such families of individual clumps, called clones, may lay the beginning of a new variety of higher yield.

SIZE OF PLANTED TUBERS (p. 67-68)

The larger the tuber the better is its race, as a rule, i.e., it will produce a higher yield compared to a smaller tuber, as indicated by Lysenko.

It is, however, not advantageous to plant large tubers in the majority of cases since too much seed material in weight will be required per hectare.

Planting of potatoes by tips offers better opportunity to utilize large tubers for sowing. Every precautionary measure is taken in order to prevent the spread of diseases.

It is desirable to grow seed potatoes of planting size, i. e., weighing about 50-75 g. (calling for an expenditure in seed material of 2-3 tons per hectare). But on a high agricultural level, at the usual density of planting, the tubers in harvesting frequently exceed the desired size. Cutting of tubers into larger pieces is less desirable since this may produce

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the infection of healthy tubers. The member-correspondent of the Esthonian Academy of Science, laureate of the Stalin award, Iu. S. Aamisepp recommends dense planting to obtain tubers of seed size in growing potatoes for seed purposes.

STORING (p. 68)

Varietal potatoes should be stored under conditions not permitting deterioration of seed qualities.

Lysenko emphasizes that under warm storage conditions tubers predisposed to aging during the winter will be produced.

The most important condition for proper storing of seed potatoes is therefore the establishment in the bins of a regular temperature regime varying within the limits of 1 to 3 degrees. At a storage temperature close to 0°, deterioration of the seed qualities of potatoes is observed.

Seed tubers from summer plantings of a previous year are well preserved for purposes of summer plantings. As indicated by Lysenko, young tubers from such yield, not having matured at the time of harvesting, do not open eyes (sprout?) for a long time and do not age during the winter.

The same may be said concerning tubers grown on cold peaty soils because these tubers are usually gathered before maturity.

Seed potatoes of earlies subjected to phytophthora should be harvested not in the customary fall periods but in an immature state (condition) in early or middle August when tubers are not endangered by phytophthora.

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CONCLUSION (p. 68-69)

The Soviet Union occupies a leading place in the world in the field of potato selection. During a comparatively brief space of time our country was able to achieve such successes in potato selection as had not been obtained by foreign science in many decades.

Our country possesses the richest collection of potatoes in the world which provides enormous sources of initial material for purposes of selection.

In utilizing the fruitful Michurin methods to produce new varieties, our native selection has first applied inter-species hybridization of potatoes. Phytophthora-resistant varieties were first created in world practice by this method, as well as two-yield varieties without tuber dormancy. Selection work covered the creation of frost-resistant varieties and varieties resistant to the Colorado beetle.

Along with the enormous achievements we admit shortcomings in selection work. Not all selective institutions devote adequate attention to problems of training in the process of producing new varieties. More attention should be paid to problems of potato seed growing and problems of supporting selection for varietal improvement.

Once a variety has been produced it demands constant work not only to preserve its varietal purity but to improve its qualities. A constant selection in varietal improvement and the severe rejection of all forms of undesirable deviations are therefore imperative.

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Lysenko proposed the theory of genetic qualitative distinction of vegetative tissues. Proceeding from this premise new methods of clonal potato selection are being developed. The works of I. E. Glushchenko and lately that of M. A. Sizova indicate that potato plants obtained from secondary buds developing from the deeper lying tuber layers differ substantially from control plants obtained from ordinary eyes by the removal of the eyes to a depth of 1 cm.

In utilizing this method it is possible to alter the undesirable color of tubers, increase yield and starch content of potatoes.

In producing frost-resistant varieties it is also necessary, aside from inter-species hybridization, to engage in the separation of those plants of which the foliage or parts of stems suffered least from frost. Parts of stems that were preserved from frost may be used for cuttings, rooted and in the following year again subjected to the reaction of frost. By means of directed selection and training of these plants it is possible to gradually produce frost-resistant varieties. Working on a foundation of advanced agro-biological science, selectors should in the shortest time possible satisfy the demands of our national economy for new early potato varieties of highest yields, resistant to phytophthora, the Colorado beetle and frost.

It is further possible to point to other tasks in potato selection, not apparent at first glance. Here one should point first to the increase of starch content in potatoes. It is not possible to limit ourselves only to the problem of increasing merely the potato yield. An increase in potato yield should be combined with a high percentage of starch in tubers. This

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would have a significant economic effect. An increase of only 1 per cent in the starch content of potato tubers will correspond to an increase of at least 10 million tons in the potato yield of the entire country.

Taking into consideration the exceptional economic significance of an increase in the starch content of potatoes, this task may not be limited to industrial varieties alone. The increase of starch content is essential for all other varieties, table and forage alike. Of particular importance is the increase of the starch content of early varieties in the northern belt of the Union and under the conditions of irrigation ("polivnye") in the extreme southern belt (central-Asiatic republics, Caucasus). Tubers of early potato varieties and varieties produced under southern conditions possess usually a low content of starch.

South American potatoes are considerably superior to cultivated varieties in albumen content. This raises the problem of increasing the albumen content of potato varieties by distant hybridization. In increasing it only 1 per cent, which is fully possible, a yearly increase in the yield of albumen for the entire potato area of the Soviet Union will be obtained, equalling in nutritional value 15 billion liters of milk, i. e., almost 100 liters a year per inhabitant.

Finally, wild potatoes may be utilized for the increase of anti-scurvy vitamin C in tubers. Wild potatoes, such as S. antipoviczii, however, containing much vitamin C, have as yet not been mastered in selection because of the inadequacy of the application of Michurin methods.

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Michurin methods will aid in solving this problem, as all new important problems faced in potato selection have been solved.

End of pamphlet

February 12, 1951

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T-72-

Sokolov, N. Herbicides. (In Sel'sko khoziaistvennaia entsiklopediia. Ed. 3. Vol. 1, p. 443-444. Moskva, 1949. 30.1 So42

Translated from the Russian by S. N. Monson

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HERBICIDES

Herbicides are chemical substances used for the destruction of weedy plants. They are applied to the external parts of weeds (usually young shoots) or are entered into the soil to act upon the underground organs of weeds and their seeds (usually during their germination). Some of the herbicides, (of local activity) kill off organs or parts of plants upon which they act directly; others (of general activity) in spreading throughout the vascular system of the plant result in the complete or temporary destruction of the entire plant. The local activity of herbicides kills only the seed-grown weeds, while in the case of perennial weeds the above-ground part alone is destroyed. Herbicides of general activity kill both annual and perennial weeds completely.

In addition, one distinguishes toxic herbicides used for cultivated, as well as weedy plants (for instance, chlorates) and herbicides of selective activity, which when killing any of the weeds (in definite doses) do not injure the cultivated plants among them. The sensitivity of plants to herbicides depends upon the size of the plant's leaves (broad-leaved plants are, as a rule, more affected than narrow-leaved ones), as well as upon the distribution of the latter and the character of the leaves' surface (pubescence, waxy, etc.), also upon the protection accorded the point of growth (in two-lobed plants it is less protected, as a rule,

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Sokolov, N. Herbicides. In Sel'sko....
p. 443-444.

than in single lobed ones) and upon the biochemical peculiarities of the respective plants. Cereal crops are considerably more resistant to herbicides than are broad-leaved, two-lobed plants, particularly susceptible to them are Cruciferae, Compositae and several other plants. This permits the selection of definite herbicides (chiefly of local activity) for the control of weeds in planting cereal and fodder crops (chemical hoeing). To these herbicides belong: 3-5 percent solution of sulfuric acid, 15-50 percent of ferrous sulfate hepta-hydrate, copper sulfate, cupric chloride, sodium bisulfate, calcium cyanamide, finely crushed kainite, etc. These herbicides will destroy the shoots of wild radishes, mustard, wintercress, cornflower, hempnettle, knotweed, smartweed (Polygonum L.) among sowings of wheats, barley, millet. Some of these herbicides may be utilized also for chemical hoeing in plantings of flax and onion. The use of the above herbicides is, however, connected with certain difficulties because of their bulk (large quantities of herbicides are required), and the poisonous nature of many of them is injurious to livestock, etc. (Of considerable convenience are those herbicides where activity is provided in small doses, for instance, the combination of dinitroorthocresole, primarily in the form of sodium salt). The effectiveness of this type of herbicide (sinox, khedolite, etc.) is increased by the addition of components-activators, such as sulfuric acid, ammonia, sodium bisulfate. The expenditure of "sinox" and "khedolite" on sowings of cereal crops amounts to 5-10 kg/h., while the use of dinitroorthocresole is 1.75-3.5 kg/h.

Among the highly effective herbicides of selective activity are some GROWTH SUBSTANCES, especially the derivatives of chlorine phenoxy-acetic

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acid; 2-methyl-4-chlorine phenoxy-acetic acid (methoxyl), 2,4-dichlorophenoxy-acetic acid (2, 4-D), used primarily in the form of sodium salts in doses of 0.5-1.5 kg/h. Under the influence of these herbicides weeds stop their growth, at first without losing their green color and without dying. Subsequently they develop characteristic deformities (thick or crooked stems, etc.); they die in 2-3 weeks, occasionally earlier, as do Cruciferae; sometimes later.

The above herbicides are used in solution form or in a dry state. In the latter case they are mixed (for a uniform distribution) with inert dilutions, such as, kaolin.

Planted areas are treated during the tillering period; in the case of some herbicides even earlier (khedolit), when the weeds have grown 2-4 leaves, and in this instance - knapsack, horse-or tractor-driven sprayers or dusters are being used.

We know of toxic herbicides used primarily for cereals (urethan-ethyl carbamite) and of herbicides which destroy weeds in sowings of cultivated plants of other families. Thus, for instance, some petroleum products will kill cereals and several other plants but prove harmless to plants of the Umbelliferae family, and may be used in controlling weeds on sowings of carrots and celery.

Herbicides which are toxic to all plants may be used in the fields not planted with agricultural crops(prior to sowing or after harvesting on fallows) and on non-cultivated soils. The above mentioned selective herbicides belong to herbicides of general toxicity, which are applied in

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large doses (toxic to all plants) but since the greater part of these herbicides (except for the growth substances which belong to herbicides of general activity) does not affect the underground runners of perennials (only above ground runners get destroyed), it is desirable to apply herbicides of general activity.

Among the herbicides of general activity the best known is sodium chloride (chlorate). Spraying with a 15-20 percent solution of $NaClO_3$ (up to 2000 liters per hectare) kills the major part of the weeds; among these such stable varieties as European glorybind (Convolvulaceae arvensis L.), (Sonchus arvensis L.)- Field sow thistle, etc. A similar effect is produced by calcium chlorate and potassium chlorate (Berthollet's salt) etc. Herbicides of general action are applicable also in the destruction of weeds on forest roads, etc. The residue of benzol production may also be used for the same purpose. Chlorates may also be applied to control grass weeds in forest cultivation.

Among the herbicides used for the sterilization of the soil are chloropicrin, chlorates, carbon bisulfide, borax (sodium tetraborate), etc. Herbicides of this group should be of high chemical and physiological activity (to crush the viability of weed seeds) and decompose rapidly in the soil, otherwise the latter may not be used for agricultural planting for a long time. Chloropicrin kills the root system of weeds but its effect is weaker upon their seeds, of which it kills only the germinating ones. Chloropicrin acts positively if applied directly to the soil, by activating the microbiological processes that take place in it. Sodium chlorate does not decompose rapidly in the soil; there are instances when

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following the application of sodium chloride agricultural crops have produced lower yields in the first and second years.

Some herbicides of selective activity may be utilized for the partial and temporary sterilization of the upper layer of the soil;this will cause the dying of the germinating shoots of weeds. Thus, upon introducing methoxyl, following the sowing of cereal and other crops of slow growth, one is able to destroy the shoots of weeds which appear earlier than those of cultivated cereal crops or simultaneously with them. Sterilization of soils is of considerable significance to hothouse and truck garden soils. Some herbicides serve at the same time as fertilizers, such as calcium cyanamide, kainite, etc.

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End of article. -

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Skripchinskii, V. V. Chto takoe rostovye veshchestva i kakoe znachenie oni imeiut dlia sel'skogo khoziaistva [What are growth substances and of what importance are they in agriculture]. Stavropol', Kraevoe Knizhnoe Izd-vo, 1948. 50 p. 465.36 Sk6

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Translated from the Russian by
S. N. Monson

The author, who has a scientific degree in agriculture, wrote this pamphlet for the benefit of collective farmers, the article representing one in the series of popular scientific literature. He surveys the history of growth substances and refers to the role which Russian scientists have played in their development. (pp. 5-20).

Part II, (pp. 20-30), is devoted to the Practical Utilization of Growth Substances, following the theoretical work begun in the middle thirties and succeeded by experimental work in the field for production purposes.

Prior to the war several state farms widely applied growth substances for the vegetative propagation of sub-tropical plants; such as the large-flowered jasmin, the chinchona tree, and the cocaine shrub. The work was continued in spite of the German invasion and good results were obtained at the state farms "Kraskovo" and "Leninskie Gorki" of the Moscow oblast, as well as on other farms of the Kiev oblast, following the expulsion of the German armies. It appeared certain that once the industrial production of growth substances may become organized on a large scale, the country would take a leading role in the field of their practical utilization.

ROOTING OF SLIPS was among the first tried and the practical methods used in the application of growth substances are therefore more developed.

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Skripchinskii, V. V. Chto takoe....
[What are growth substances....]

As a result of works of Soviet scientists in this connection, performed by - N. A. Maksimov, M. M. Gocholashvili, E. I. Kochershenko, D. P. Snegirev, D. A. Komissarov, R. Kh. Turetskaia (Maksimov's assistant), the following two methods were recommended: 1) submersion of the lower part of slips in a solution of heteroauxin for a definite period; and 2) the dusting of the moist cut of the slip with talcum powder or ground charcoal mixed with heteroauxin. Aside from heteroauxin, slips may be rooted with the aid of the following substances: 2,4 - dichloro-phenoxy-acetic acid and 2,4 dichlorophenoxy [oil?] acid, their ethers [?] and salts.

Another use made of growth substances was to promote the PRODUCTION OF SEEDLESS FRUITS AND THE GENERAL INCREASE IN YIELDS OF FRUITS AND SEEDS. This phase of the work is very young yet but may possibly become the most important from an economic point of view. (Experiments made by Dr. I. I. Tumanov; the Soviet scientist Y. V. Rakitin; M. I. Yakushkina.)

THE RETARDING OF THE GROWTH OF BUDS. (of importance in early spring seasons.)

CONTROLLING THE FALLING OF FRUITS PRIOR TO THEIR HARVEST.

CONTROLLING INJURIES TO GERMS CAUSED BY FROSTS.

WEED CONTROL (p. 28-29)

Weed control by the use of chemical methods has recently attracted more attention on the part of scientists and practical agricultural workers. Here too growth substances are destined for a bright future. Their

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[What are growth substances....]

utilization consists in that growth substances, if applied in fairly large dosages, are capable of damaging and even killing plants. Of still greater significance is the circumstance that the degree of injury caused to diverse plants varies. Cereal crops, such as wheat, rye, barley and oats, etc., are distinguished by particular resistance.

Taking this into consideration one may spray and dust the sowings of these cereals. The cereal crop will remain uninjured, while the weeds will perish.

The most effective herbicides for the purpose are 2,4 - dichlorophenoxyacetic acid; 2-methyl-4 chlorophenoxy acetic acid; beta - naphthoxyacetic acid and alpha naphtholeneacetic acid, applied in 0.025-0.25 percent solutions.

Growth substances produce positive results in weed control on fallows. They are mixed with soil for the purpose which is then spread over the field and plowed in. The vapors of growth substances destroy the seeds of weeds in the soil at the time of their germination and no germination takes place therefore on such field. Cereal crops sowed in such soil produced normal growth two months after treatment. Growth substances proved particularly useful for the destruction of such weeds as early winteroress (Barbarea R. Beck), field pennycress (Thlaspi arvense L.), saltbush (Atriplex L.), glorybind (Convolvulus arvensis L.), yellow sow-thistle (Sonchus L.), etc.

The work of applying growth substances for weed control has only begun but the achievements to date lead one to believe in the enormous possibilities that open up in this direction.

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Skripchinskii, V. V. Chto takoe....
[What are growth substances....]

OTHER METHODS OF UTILIZING GROWTH SUBSTANCES - have not been accepted in practice as yet but they, nevertheless, deserve attention and will, undoubtedly, soon receive necessary consideration. Growth substances, for instance, will speed the ripening of fruits; they may also be applied to improve the condition of fruit trees which may have suffered damage during the winter, increase the effect of grafts, the formation of crowns of trees, control the periodicity of fruit bearing, and finally, cause changes in flowers and leaves which under the influence of growth substances acquire bizarre shapes, particularly valued in ornamental horticulture. Attempts have been made to apply growth substances in controlling the lodging of cereal crops and aiding in the destruction of fungi parasites.

The above refers to the utilization of growth substances which are introduced externally into the vegetative organism. There appears before us, however, a more grandiose task, - covering the physiology of plants - how to take possession of methods to control the formation of growth substances within the plant itself. The solution of this task is bound to introduce a revolution in the entire problem.

The above enumerated methods of the practical application of growth substances were literally born within the past few years. Many have already been widely accepted in production, others are under test, the third are studied in scientific experiments. One may therefore but agree with the academician N. A. Maksimov who reminded us in concluding his report that "we have so far taken from growth substances only a part of what they may eventually contribute to practical work..."

End of pamphlet.

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T-74

Rakitin, IU. Rostovye veshchestva.
Kolkhoz. Proizvod. 7(12):44. Dec. 1947
281.8 K83 Effect of growth substances
on plants.

Reviewed and Translated in part by
S. N. Monson

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.....Still stronger solutions of growth substances were tested for the control of weeds. The treatment of weedy plots by SOME solutions of these substances destroys not only the upper surface of the mass of weeds but causes also the poisoning of their roots and rootstocks down to a depth of 30 cm. It is true that these substances poison primarily non-cereal crops and only weakly affect weeds of the cereal family. However, one may successfully use a group of other chemical combinations to destroy these species. (Omitted 8 lines.)

Growth substances may be ordered from the scientific-experimental station of the Shchelkovski department of the Chemical Society, imeni D. I. Mendeleeva, Moscow 19, Sredne-Kislovski Pereulok, No. 2. Here also may be obtained pertinent literature on the application of growth substances in plant growing.

End of Article

Professor IU. Rakitin, staff member of the Institute of Physiology of Plants imeni K. A. Timiriazeva of the Academy of Science of the USSR. Moscow.

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Maksimov, N. A. Rostovye veshchestva, priroda ikh deistviia i prakticheskoe primenenie [Growth substances, the nature of their activity and practical utilization]. Uspekhi Sovremennoi Biol. 22:161-180. 1946. Ref. 442.8 Er3

Reviewed and Translated in part by
S. N. Wenson

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V.

PHYSIOLOGICAL FOUNDATIONS IN THE PRACTICAL UTILIZATION OF GROWTH REGULATING SUBSTANCES (pp. 177-180)

....If one recognizes the influence of growth regulating substances as the most important function in the life of a plant, with respect to the translocation of organic substances in the body of the organism, their manifold action will be easily understood, though at first glance, it is difficult to explain. Let us briefly cite the most important methods of utilizing growth substances in agricultural practice by approaching them from this point of view.

Historically, the first of these methods was the utilization of growth regulating substances for the strengthening and initiation of root formation of cuttings, a procedure widely developed when the works of Hitchcock and Zimmerman (1936) of the Boyce Thompson Institute proved that synthetically prepared substances, - such as indoleacetic and naphthaleneacetic acids, to which later were added indolene fatty acids, and others, - were equally well suited for the purpose. The method received wide application in the USSR shortly thereafter, chiefly in vegetative propagation of sub-tropical crops; primarily due to the work of Maksimov and Gocholashvili (1936), performed at the Batum Botanical

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Maksimov, N. A. Rostovye....
[Growth Substances....] pp. 177-180

Gardens Kocherzhenko (1936) and Snegirev at the Suchum Selection Station of moist-subtropical crops, and Turetskaia (1937-38), of the Institute of Plant Physiology, imeni Timiriazeva, Academy of Science of the USSR.

The introduction of this method, particularly in our subtropics, was especially aided by Snegirev who organized at Suchumy the manufacture of synthetic growth regulating substances which, while produced in small amounts, were adequate for servicing a limited subtropical area along the Caucasian Black Sea shore. The application of growth substances for root cuttings spread subsequently into other regions of our Union, intensive publicity given this method playing a considerable role in this connection. This advertising was done by the staff of the Institute of Plant Physiology of the Timiriazev Academy, and was particularly aided by their publishing detailed instructions on the application of growth regulating substances for root cuttings of the most diverse crops (Chailachian and Turetskaia, 1942). Of great significance was also the development of the method of synthesizing heteroauxin and indolene fatty acids at the Moscow University laboratories by the academician S. S. Nametkin and the manufacture of these substances there (though on a small scale) for the benefit of Soviet agriculture. The introduction of growth substances on a wider scale was hampered by the fact that up to now the manufacture of the latter was not organized to produce sufficiently large quantities in the USSR. In this respect we are far behind of the USA and Western European countries, where, prior to the war, growth regulating substances could be purchased at any drugstore in

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Maksimov, N. A. Rostovye....
[Growth Substances....] pp. 177-180

necessary amounts, at fair prices. (Omitted 17 lines on p. 177).

p. 178....The application of synthetic growth substances in another field concerns their use in preventing young fruit-drop. Spraying (of fruit trees, in particular) was done for this purpose with weak solutions of growth regulating substances. The latter strengthen the influx of nutritious substances to fruits and prevent the premature formation of the abscission layer which is the cause of their drop when not mature. The utilization of growth substances for this purpose has assumed large proportions in the USA. In our country this method has been successfully used by professor I. I. Tumanov of the Institute of Plant Physiology, Timiriazev Academy, in controlling fruit-drop of alfalfa. Wider utilization was again prevented by the lack of an adequate supply of these substances at orchards of state and collective farms and even at experiment stations, as well as the lack of suitable spraying equipment for the thin spraying of solutions of growth substances.

(Omitted balance of p. 178 and upper part of p. 179)....concerning the experiments of the American Gustafson (1936) and those of Zimmerman and Hitchcock (1944) with aerosol. The latter method is widely used in hothouse tomato culture in the USSR.

p. 179....The most important task at present is to introduce growth regulators as widely as possible into agriculture and to individualize methods for diverse crops. The main burden in practical work will fall upon agricultural experiment stations; while the role of the institutes of the Academy of Science will be to concentrate on publicizing these

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methods and also organize the manufacture of growth substances in quantities ample to meet the needs of at least experimental institutions and the more progressive state and collective farms, prepared to undertake the work but handicapped by their inability to secure the products.

With this in mind, the Academy of Science of the USSR established at present a special laboratory for the manufacture of those growth regulating substances that are already known, as well as for the development of new ones that may prove of greater activity and less poisonous, (all growth substances are poisonous in larger and smaller degrees) or at least less expensive and thus more accessible. The academician S. S. Nametkin expressed the desire to head this laboratory, which would ensure the success of the project.

Finally, future tasks to be undertaken at our institute, as well as by other Soviet botanist-physiologists, are research and experimentation of new ways of applying growth regulating substances. We also find in foreign scientific agricultural literature a series of attempts to utilize growth substances for controlling damage caused to unripe fruit by spring frosts; to be used as WEED KILLERS, and to preserve cut flowers and other parts of plants in a fresh state for longer periods, etc.

I cannot dwell here upon these attempts, since this would lengthen my article too much, and therefore limit myself to the statement that we have, up to the present time, taken from growth substances only a part of what they can contribute to practical work and that it is imperative that

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Maksimov, N. A. Rostovye....
[Growth Substances....] pp. 177-180

we in the shortest time possible utilize them to the fullest extent, extracting from the new technical means all it is able to provide.

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End of article.

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Translated in part by
S. N. Monson

The study of the so-called growth regulating substances promised tempting prospects for agriculture as a simple means of increasing yields. They have, nevertheless, not received wide application in practice so far. As it seems to us, this may be explained primarily by the uncertainty (vagueness) of their effect upon a plant. Their action depends upon many factors: crop, variety of plant, various external conditions. Aside from that, along with such positive facts as a reduction in fruit-drop, the acceleration in the ripening of tomatoes and other plants, following their treatment with growth regulating substances, negative traits were also observed, particularly, an increase in fruit disease. The great disadvantage in growth regulating substances is the circumstance that the substances strongest in activity among them, and of positive effect, such as 2,4 D, may at the same time produce undesirable changes in the leaves which resemble in character those produced by virus diseases.

Upon an assignment by T. D. Lysenko and under his supervision, a study of chemical substances upon plants was conducted at the Institute of Genetics of the Academy of Science of the USSR, lasting two years (1947-48). Of particular interest were the compounds which easily produce changes in the shape of leaves. The reagent in the case was 2,4 D (Dichlorophenoxyacetic acid).

Experiments were primarily conducted with tomato plants. The following problems were studied:

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Ivanovskaia, T. L. Effect of 2,4 D....
pp. 113-126

1) the morphological changes in plants produced by the reaction to 2,4 D;

2) the action of varied concentration of 2,4 D upon tomato plants, depending upon their age and external conditions;

3) the transmission of changes produced in the leaves of tomato plants by 2,4 D to healthy plants through grafting.

(Omitted pp. 114-125)

p. 125....Thus our experiments have demonstrated possibilities of the infection of healthy plants by diseased plants through grafting, following their treatment by 2,4 D. This evidently points to the fact that the morphological changes observed in plants, following their treatment with a solution of 2,4 D, are connected with changes "in the direction of processes in the cells", which may in division be further transmitted to succeeding cells during the entire life of the plant, as well as by grafting to healthy plants.

There are indications in literature to the effect that following the TREATMENT OF WEEDS WITH 2,4 D OF HIGH CONCENTRATION, a twisting of the of 2 1 plants
cotton leaves was observed on adjoining lots. Individual plants with leaves of changed shape were discovered at such distance from treated spots that the fact could not be traced to the evaporation of the preparation, nor to infection through watering. It is possible that in this case an infection through the juice of the diseased plants took place transmitted by insects, of a kind similar to that which had occurred in our grafting experiments.

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pp. 115-126

The fact that the changes of the leaves of plants, after treatment with 2,4 D, appear to be the result of changes in the physiological processes of cells, is substantiated by the circumstances that we did not observe in our experiments any changes in the leaves during the direct treatment of plants with a weak concentration of 2,4 D (1-3 mg per liter). Hardly noticeable and rapidly disappearing changes were observed following the treatment with a solution of a concentration of 5 mg per liter, while in some cases, when only one leaf had been treated with the solution of a concentration of 10 mg per liter, the plants produced up to 30 and more changed leaves. This already speaks not only of the direct influence 2,4 D exerts upon succeeding leaves, but also of the possibility of a transmission of changes to the daughter cells through the infection of healthy plants by the juice of plants treated with 2,4 D.

It is difficult to establish the transmission of changes observed in the seed progeny of tomato plants following their treatment with a 2,4 D solution, so long as the fruits on diseased plants remain of normal shape, although they do not bear seeds. Finally, we stress that based on the literature on the subject and our experiments - the changes in plants, as a result of their reaction to 2,4 D and similar preparations, resemble those observed in plants affected by virus diseases. It is evident that the virus albumen secreted by diseased plants is in some form related to such preparations as 2,4 D in its action.

It has been established that virus diseases may be transmitted through healthy plants by grafting. Along with such virus forms as,

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for instance, mosaic, which easily affects plants, other virus diseases are known which are difficult to transmit in grafting.

As has been established, healthy plants may be infected directly through the juice of diseased plants, or the infection may be transmitted by insects. It is known that many insects, especially aphids, which are transmitters of virus diseases, contain growth regulating substances.

(Omitted 18 lines, p. 125 and 126)

p. 126....It is possible that the disease of plants, as result of a treatment with 2,4 D, various virus diseases, and finally divergences from standard forms, under the influence of external conditions - are all symptoms of one order and are connected with the disturbance taking place in the physiological process in the cells. The degree of infection among healthy plants by diseased plants may differ and will be strongly dependent upon external conditions. It is evident that external conditions, abnormal for the development of any plants, will increase their chance of succumbing to disease by infection through the juice of changed plants.

Conclusions

1. In treating plants with a solution of 2,4 D, it was observed that the change in the shapes of leaves of plants was increased in proportion to the increase in the concentration of the reagent.

2. The reaction of the solution of 2,4 D upon tomato plants depends upon their age. Prior to budding, the plants react stronger to treatment and regain their health more rapidly than during the budding period.

3. The reaction of the solution 2,4 D upon plants depends also upon external conditions. Plants, grown in identical surroundings, but left

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after treatment in a hothouse or placed into conditions unusual for their development, react much stronger to treatment than do plants placed after treatment into open ground.

4. Under the influence of external conditions, abnormal for the development of plants, and by growing them in the fall-winter period, or in the summer in a darkened dry place, similar changes may occasionally occur in the leaves of tomatoes, as were observed following a 2,4 D reaction.

5. Changes observed in plants after treatment with 2,4 D can be transmitted to healthy plants by infection through the juice and by grafting.

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End of article.

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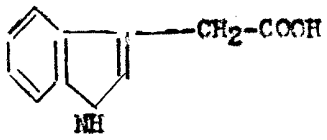
Razumovskii, V. V. Growth substances [for plants]. (In Russian.) Priroda 37(6): 46-48. June 1948. 410 P933

Translated from the Russian
by S. N. Monson

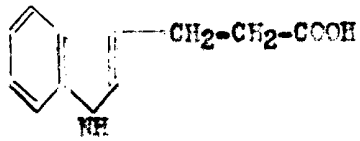
GROWTH SUBSTANCES [FOR PLANTS]

It has been observed long ago that illuminating gas when contained in small concentrations in the air affects plant growth. Investigation has showed that carbon monoxide is the activating substance in illuminating gas that affects plant growth. The stimulating influence of ethylene, acetylene and propylene on root growth of plants was subsequently established.

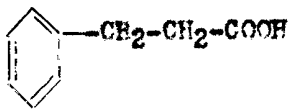
F. Kögl first isolated growth substances of plants as a pure chemical compound and determined its structure. It seemed that the growth substance of plants was beta-indoleacetic acid (Chem. Review, 39, 199, 1946):



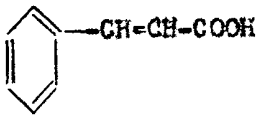
Hitchcock, in testing many chemicals, found that, in addition to beta-indoleacetic acid, beta-indolepropionic acid, phenylpropionic acid, and phenylacrylic acid were effective in causing root initiation:



beta-indolepropionic;



phenylpropionic;



phenylacrylic.

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Shortly thereafter new organic combinations were discovered which exerted special reactions upon plants. This group of combinations, consisting in the molecule of the kernel of napthalene, anthracene and indole (alpha-napthaleneacetic acid, beta-napthaleneacetic acid, beta-indoleoil acid, anthraceneacetic acid) all effectively influence plant root growth.

The addition to the soil of any of these substances is sufficient to produce root changes in the growing plant. It was further found that the complicated ethers alpha-napthaleneacetic acid, phenylacetic acid, beta-indoleacetic acid, beta-indolepropionic and beta-indoleoil acids, also belong to these vegetative growth substances.

For the primary root growth of plants the salts alpha-napthalene-acetic and beta-indoleacetic acids proved also strongly effective.

It is most interesting that growth substances which stimulate the development of the stem, the petiole and the root formation, in the same concentrations as the above-mentioned two acids, interfere with root growth of plants.

There exist also a series of other growth substances, herbicides which either stunt or prevent plant growth. The possibility of their wide application in the future for the most varied purposes is determined by the following:

1. These growth substances may be applied for eliminating superfluous flowers and fruits;

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2. Herbicides may serve as weapons for weed control;

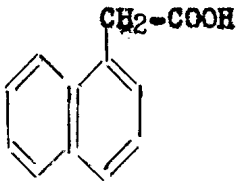
3. They may successfully be utilized to stunt the development of buds, flowers, and leaves of early trees and shrubs.

The application of herbicides in this direction offers the opportunity to avoid the damage caused by early frosts to plants and, on the other hand, to prolong the period of blooming and fruiting.

Herbicides [illegible] permit the lengthening of periods of planting shrubs in the spring. Growth substances are also used to prevent early budding in potato tubers.

Of particular interest is the "differential" (selective) herbicide. This herbicide stimulates the rapid development of wide-leafed plants, to the point of their complete destruction. At the same time the action of this herbicide does not extend to grasses.

The field of application of growth substances in gardening for spraying fruit trees is rapidly spreading. Such growth substances as beta-indoleacetic acid and methyl-ether of alpha-naphthaleneacetic acid delay the development of buds on fruit trees. In order to prevent the harmful influence of late frosts and to prolong the period of fruit ripening on trees, the latter are treated with vapors of alpha-napthaleneacetic acid



Alpha-napthaleneacetic acid prevents June drop of apples and retards the blooming of trees.

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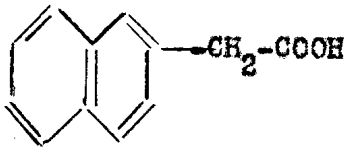
Particularly effective is the growth substance beta-napthaleneacetic acid



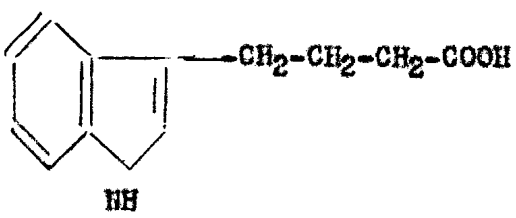
and its potassium and sodium salts.

In a brief space of time insignificant concentrations of beta-naphthaleneacetic acid produce a harmful effect on plants.

Still more effective is the growth substance 2,4-D. This organic compound destroys all plants that grow in the field without damaging grasses.

Simultaneously, 2,4-D speeds the ripening of apples, pears and bananas. While tomatoes and peppers are completely indifferent to the effect of 2,4-D.

The beta-indoleacil acid



stimulates propagation of plants. Specifically, it aids the formation of fruits of tomatoes.

Napthoacetic combinations (betapnaphthoacetic acid) transform plant organs. More effective yet as growth substances are the derivatives of phenoxyacetic acids: 2,4-D and 2,4,5-T (trichlorophenoxyacetic acid).

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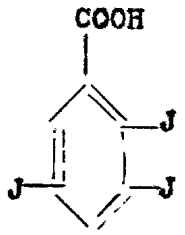
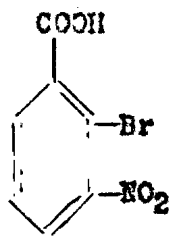
They retard the development of plant buds, contribute to the formation of seedless fruits and prevent immature fruit drop.

Benzoin acid is physiologically inactive (non-active). The substituted benzoin acids -- 2,3,5 tri-iodobenzoin acid (1) and 2-bromo-3-nitro benzoin acid (2):



(1);



(2)

are physiologically active.

Acid (1) is the regulator of plant growth; acid (2) affects the lengthening of plant cells and especially the modification of organs.

2-chloro-nitro benzion acid is non-active in lengthening plant cells but it modifies organs.

Methods of treating plants with growth substances vary.

To prevent June drop of apples a water solution containing 10-50 mg. of alpha-napthaleneacetic acid per liter is sprayed over the entire tree.

To retard the development of buds on tubers, bulbs, trees and shrubs, the plant or part of it is frequently subjected to the effect of vapors or submerged in a solution, or yet dusted with the powder of alpha-napthaleneacetic acid preparation. The most effective retardation of plant growth is achieved by treatment with vapors of methyl and ethyl

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ethers of beta-napthaleneacetic acid.

Seedless tomatoes are obtained by using various methods.

The most usual method consists in spraying wilted flowers with water solutions, or emulsions of beta-indoleoil, beta-napthoacetic, beta-napthoacetiopropionic, or 2,4-D acids.

The method of ducting with 2,4-D is at present used for weed killing.

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Lebedev, D. V. Herbicides - potential weapon in chemical warfare. (In Russian.) Priroda 1947(6): 50-52. June 1947. 410 P933.

Translated from the Russian
by S. N. Monson

BIOCHEMISTRY

HERBICIDES - POTENTIAL WEAPON IN CHEMICAL WARFARE

Growth substances used in high concentrations for controlling weeds have been named herbicides to be analogous to insecticides and fungicides. The possibility of their application is derived from the fact that different plants at different stages of their development possess varied degrees of sensitivity to these substances. As a result, herbicides /in destroying common dicotyledonous (wide-leafed) weeds do not damage cultivated cereals.

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Further work on the problem was transferred in the USA to the Special Projects Division, Chemical Warfare Service; the publication of the principal discoveries was discontinued, however, because of the possibility of using herbicides in destroying crops of an enemy country.

Beginning February, 1944, a large group of American botanists, headed by Dr. A. D. Norman, conducted research which received the convenience-designation "Project Camp Detrick", the results of which were published only in June, 1946 in the Botanical Gazette in 18 articles. The program of the work was first outlined by Professor E. J. Kraus and limited parts of it were conducted at the University of Chicago, as well as at the Beltsville Experiment Station of the Bureau of Plant Industry, US Department of Agriculture. The principal research was, however, conducted at Camp Detrick in the State of Maryland.

From the beginning the search for new synthetic substances

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possessing herbicidal qualities, was conducted on a large scale. 1060 chemical combinations were tested, of which the largest number were synthesized for the purpose. The work on the synthesis of potential herbicides was performed under the guidance of M. S. Newman of Ohio State University. Three tests ("proby") were applied. In the first test the solution of the substance under test was added to water in which were grown seeds of corn on filter paper. Four days later the length of the original root was measured and the herbicidal activity determined on the basis of growth retardation. It was expressed in percentage, depending on the effect of 2,4-D (dichlorophenoxyacetic acid), accepted as standard ("etalon") herbicide, already used in agricultural production.

In the second test a drop[let] of water solution of the substance under test was applied to the upper surface of one of the original leaves of the young plant of a kidney bean, 7 to 10 days old. Ten days later the weight of the top (tip) of the plant (above the second node) was determined. In the third test a drop[let] of oil herbicide solution was used instead of the water solution and the reaction determined upon a two-weeks-old plant. The results of both the second and third tests were compared with those of a similar reaction of dichlorophenoxyacetic acid (which we shall in the future designate by the convenience term 2,4-D.)

All chemicals under study were divided into six groups, depending upon the nature of their reaction; the experimenters were able to locate some herbicides that were considerably more effective than 2,4-D (exceeding the action of 2,4-D by 1.5 to 2 times in individual tests.)

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Simultaneously, a detailed and deeper research was conducted at Camp Detrick, on the mechanism of the activity of 2,4-D upon a plant; the various directions of the movement of herbicides were studied and the susceptibility of the different tissues to them. It was thus established that the greatest brake upon growth is caused by depositing the herbicide upon the upper parts of stems and the young leaves. The meristem and the tissues capable of returning to the meristematic condition possessed maximal sensitivity.

The most effective methods of spraying plants with water and oil solutions of herbidides were studied in detail. It was thus established that herbicides of very high concentration were not required at all. The herbicide most effective for kidney beans, used in experiments made by Smith, was the spraying of plants with 2,4-D of a concentration 0.0125 - 0.250 per cent and in the amount of 10 to 20 ml. per square yard. The increase or decrease of the volume of the solution led to the lowering of the effectiveness of the reaction. Spraying of herbicides in relatively large drops proved more efficacious. The application of such insignificant volumes of herbicides as 2 to 4 ml. per sq. yard is possible but demands a progressive increase of the concentration of herbicide to 1.5 - 3 per cent and a corresponding increase of the total use of the growth substance.

The influence of rain falling after the spraying of plants was particularly studied to judge the possibility of herbicide use in rainy weather. It was established that oily solutions of 2,4-D remained fully effective when rain fell immediately following the application of the herbicide. Water solution proved less stable. Rainfall, even 24

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hours later, reduced the efficacy of herbicides considerably. In some cases the arresting action of herbicides upon plants begins to show already within one hour after their application.

The greater part of the above experiments was made upon bean crops; soya and kidney beans. Tests of other crops were of particular interest. It was found that 2,4,5-trichlorophenoxyacetic acid ammate possesses a selective "discriminatory" action upon potatoes, while 2,4-D and 2-methyl-4-chlorophenoxyacetic acid, and an entire series of other compounds successfully used in controlling weeds, do not have any herbicidal effect upon potatoes. One month after spraying potatoes with 2,4,5-trichlorophenoxyacetic ammonia (water solution, 0.1 g. in 50 ml. of water per square yard) the height of the plants was measured and two months later the weight of tubers taken. The growth of the foliage was reduced by half, while the average weight of tubers had fallen from 64.4 g. to 9.6 g.; the tubers were covered with warts and scabs. The injury did not penetrate deeply into the tubers. In the summer of 1945 the experiments were transferred into the fields. This established the high efficacy of the application of oily solutions of 2,4,5-T which reduces the yield six times. Water solutions, while not reducing the yield substantially, radically injure the quality of the tubers by causing injuries to the upper surface. It is of interest to note that oil solutions of 2,4-D and 2-methyl-4-chlorophenoxyacetic acid, while not affecting the quality of tubers, radically reduce the yield in contrast to the water solutions which have no effect whatever upon potatoes. Preliminary research indicated that the herbicidal action of 2,4,5-T is equally effective if introduced into the soil.

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A substance possessing considerable herbicidal activity upon crops was also discovered. Beginning 1929 some experimenters had studied the influence of different combinations of urethane series upon plants. The most effective of these was found to be iso-propylphenylcarbamate, first applied by Templeman and Sexton.

Iso-propylphenylcarbamate, added in liquid form to the soil in the amount of two English pounds per acre, completely curtails the growth of barley, as well as of buckwheat, but does not have any effect upon the growth of soya beans and turnips. A similar dose of 2,4-D and 2-methyl-4-chlorophenoxyacetic acid stops the development of turnips and soya, while it does not interfere with the development of barley and buckwheat seeds, although the growth of young plants is somewhat delayed. The experimenters began therefore a search for the most active and universal mixtures consisting of herbicides of both types.

In further experiments the significance of the time of introduction of iso-propylphenylcarbamate into the soil was studied. In introducing the herbicide simultaneously with the sowing of oat seeds, pathological factors were observed from the beginning of growth. The coleoptile was shorter and thicker than normal, its tip began to get brown, and the necrotic processes spread from above down. The majority of plants perished and only 5 to 10 per cent survived, the average weight of the surviving plants reaching only 14 per cent of their normal weight. At a later introduction of herbicides, when the young plants were some 10 cm. high, the reaction was not immediately perceptible but showed in the next two or three days. Twenty-three days later all plants perished.

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Control experiments were performed of the sensitivity of various crops to isopropylphenylcarbamate. In these tests oats, soft wheat, barley, corn, rice and Italian millet were studied. Only the last-named crop proved tolerant to the herbicide. Relatively tolerant were rice, next corn and barley; the least tolerant were wheat and oats. Part of the plants perished and the entire green material of the remaining plants of the last two crops, determined 23 days after the introduction of the herbicide into the soil, amounted to only 20-30 per cent of the corresponding control figures. The yield of rice, following the addition of iso-propylphenylcarbamate to the water mixture, was radically reduced even when the plants were 3.5 months old.

In the summer of 1945 experiments with iso-propylphenylcarbamate were transferred into the field. In these experiments the mixture of the above herbicide was used with 2,4-D, in the proportion of 1:1.5 English pounds of herbicide per acre; this produced a reduction of the yield of winter wheat by one half. Ten pounds reduced the yield to 12 per cent, and when 20 pounds were introduced, the yield did not exceed 1.5 per cent control, i.e., was practically destroyed. Similar results were obtained in experiments with oats. The earlier the herbicide was introduced, the more noticeable the reaction.

Considering that iso-propylphenylcarbamate dissolves very poorly in water, it was dissolved prior to spraying in a double volume of tributylphosphate. The solution obtained was then mixed with oil and the plants sprayed with the mixture. Experiments conducted on winter rye under field conditions proved that ten pounds of herbicide per acre were sufficient to destroy the entire harvest.

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We were able to present the results of these most important investigations only in the most general outlines; their full description takes over 150 pages. Aside from the above-mentioned crops many others were used in the experiments, including tomatoes, cabbage, sugar beet, batata. Practically none of these agricultural crops may be considered absolutely tolerant to herbicides, since a specific herbicide may be found for each plant. The possibility of utilizing herbicides as a weapon in chemical warfare for the mass destruction of plantings stemmed from here and compelled the secrecy of the work. At the same time research conducted on such vast scale has considerably enriched our knowledge of the possibilities of the peaceful application of synthetic growth regulating substances in agriculture. If, according to the American physiologists, the use of growth regulating substances for controlling the dropping of fruits fully compensates for the expenditures of the scientific research on the subject, the potential application of many new preparations, even as herbicides, will be worth the costs spent upon "Project Camp Detrick."

End of article.

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T-77

Lekhnovich, V. S. Newest methods of weed eradication. Priroda 35(4): 58-60. 1946. 410 P933

Translated from the Russian
by S. N. Monson

PLANT GROWING

NEWEST METHODS OF WEED ERADICATION

A more intensive study of the stimulating activity of small doses and of the retarding effect large doses of the hormones of beta-indole-acetic acid upon root formation of cuttings and alpha-naphthylacetic acid upon the germination of seeds, sprouts and the development of plants, have demonstrated vast differences in the reaction of various plants upon identical concentrations of the above hormones and have made possible the study of the destruction of one species of plants without causing damage to others growing close to them.

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The first experiment in this direction was made in England in August 1940 at the Research Institute of the Imperial Chemical Industries, Ltd. Oats infested with field mustard (Brassica Sinapis Visiani) were subjected to one treatment by alpha-naphthylacetic acid in a dosage of 25 pounds per acre (about 28 kg. per hectare.) The above weed not only was destroyed but its seeds dropped in the field during cultivation lost 84 per cent of their strength to germinate and the few sprouts of field mustard that appeared rapidly perished. Oats were only slightly damaged and quickly recovered. Wheat, barley and rice, when similarly treated, reacted in the same manner, while Achillea L. and Plantago major were destroyed, as was Sinapis L.

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The experiments conducted on selected weed killing with a large group of substances brought out three groups among the compounds tested; more strongly active, equally active, and less active substances, as compared with alpha-napthylacetic acid. The following compounds belong to substances more strongly activated than alpha-naphthylacetic acid: [Original publication by Slade, Templeman, and Sexton (Nature 155: 497) followed for chemical names in these lists instead of re-translation from the Russian]

o-methyl-phenoxyacetic acid (Na salt);
m-methyl-phenoxyacetic acid;
p-methyl-phenoxyacetic acid;
2:4-dimethyl-phenoxyacetic acid;
2:5-dimethyl-phenoxyacetic acid;
3:4-dimethyl-phenoxyacetic acid;
p-chloro-phenoxyacetic acid (Na salt);
2:4-dichloro-phenoxyacetic acid;
2:5-dichloro-phenoxyacetic acid;
4-chloro-2-methyl-phenoxyacetic acid
(the most effective substance);
4-chloro-3-methyl-phenoxyacetic acid;
beta-naphthoxyacetic acid (Na salt);
2:4-dichloro-alpha-naphthoxyacetic acid (Na salt);
methyl-beta-naphthoxyacetate;
propyl(n)-beta-naphthoxyacetate;
propyl(iso)-beta-naphthoxyacetate;
butyl(iso)-beta-naphthoxyacetate.

Approximately equal in activity to alpha-naphthylacetic acid are:

o-chloro-phenoxyacetic acid (Na salt);
2:4:6-trichloro-phenoxyacetic acid (Na salt);
ar-tetrahydro-beta-naphthoxacetic acid;
beta-naphthoxyacetamide;
beta-naphthoxyacetonitrile;
ethyl-beta-naphthoxyacetate;
butyl(n)-beta-naphthoxyacetate;
cyclohexyl-beta-naphthoxyacetate.

Of weaker activity than alpha-naphthylacetic acid are:

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phenoxyacetic acid;
p-nitro-phenoxyacetic acid (Na salt);
2:4-dinitrophenoxyacetic acid (Na salt);
alpha-naphthoxyacetic acid (Na salt);
1-chloro-2-naphthoxyacetic acid (Na salt);
2-chloro-1-naphthoxyacetic acid (Na salt);
ethyl-alpha-naphthoxyacetate.

In the following year of 1941 and in succeeding years principal attention was devoted to 4-chloro-2-methylphenoxyacetic acid (Na salt, now called Methoxone), which, as it soon proved, if used in concentrations not injuring cereal crops, stunts the growth and the young shoots of the following weeds: Ranunculus arvensis, Chenopodium album, Chrysanthemum segetum, Spergula arvensis, Papaver Rhoeas.

The above chemical compound completely destroys wild mustard when used in the proportion of 10 mg. to 1 square foot or about 1 kg. per hectare. Its solution in water in a concentration of about 0.1 per cent (1 pound per 100 gallons) destroys Rhaphanus raphanistrum, Ranunculus arvensis and Thlapsi arvense.

It may also be applied in powder form mixed with an equal amount of kaolin (China clay), and is now used mixed with ground chalk.

The department of botany of Kensington College [Imperial College of Science and Technology, South Kensington, London] has prepared a table summarizing the activities of non-organic poisons and of organic substances upon weeds (see p. 60). [Photostat of original table substituted for translation.] The complete destruction in tests of over 90 per cent of plants is indicated by plus, plus, plus; the destruction of 75 per cent by plus, plus; of over 50 per cent by plus; less than

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50 per cent by "R", and of those not sufficiently tested by the designation (R). According to data available concerning other experiments, 4-chloro-2-methylphenoxyacetic acid, if used in meadows in concentrations which do not destroy white clover, kills after one spraying species of Ranunculus, Equisetum L., in part Sonchus arvensis L. But concentrations up to 2.5 pounds per acre (or about 2 kg. per hectare) did not destroy species of Rumex L., Urtica L., and Pteris aquilina. Evidently, as one author notes, only the derivatives of the above compound possess potentialities for controlling weeds.

The shoots of clover are severely injured by cupric chloride, sulfuric acid, dinitro-orthocresol, and 4-chloro-2-metholphenoxyacetic acid, i.e. all the four agents named in the table. In a mature state clover is more resistant. With regard to flax, promising results were obtained with Na salt of dinitro-orthocresol, and with regard to corn with the already mentioned 4-chloro-2-methol-phenoxyacetic acid.

In controlling weeds of onion and leek (Allium porrum), the non-organic compounds indicated in the table have great possibilities.

The Rothamsted Experiment Station was engaged in the study of the mechanics of activity of the above organic substances. A solution of Na salt of 4-chloro-2-methylphenoxyacetic acid is absorbed in plants by their leaves, as well as their roots. The dilution of 1:1,000,000 or, as already mentioned, of about 0.5 lbs. per acre (about 1 kg. per hectare) proves effective. The injured plants perish with a combination of symptoms which resemble virus infection. Leaf blades are deformed;

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length of rooting systems is shortened radically, although the variations in reaction of individual species to the named concentrations are large. Thus, for instance, the root system of wheat does not react, according to the Rothamsted station, upon the presence in the soil of 4-chloro-2-methylphenoxyacetic acid of 1:1,000,000 concentration. The root system of sugar beets, under conditions of the same concentration, is shortened 12 to 15 per cent as against the normal one.

The first experiments on the subject were made by Slade, Templeman and Sexton. The amazing results were reported to the Agricultural Research Committee which immediately drew in a group of scientific workers and experimental institutions for a coordinated solution of the problem.

It is necessary to stress the importance of the established facts in the light of the exceptionally short duration of the work. The experimenters were faced with the very important task of replacing labor-consuming summer hoeing (weeding) of cultivated agricultural plants with spraying or dusting crops with a substance harmless to the plant under production. With respect to the British flora of annual weeds (which does not differ radically from ours), they succeeded in achieving substantial success for field crops. In the Journal "British Ally" (Britanskii Soiuznik) (No. 168 of October 28, 1945), the authors refer to Methoxone, which represents the above-mentioned synthetic Na salt 4-chloro-2-methylphenoxyacetic acid (named erroneously acetone in the above journal) which was produced beginning in 1944 on a limited scale; in 1945 special expeditions organized within 40 days over 120 experiment plots all over England, of a total area of 13 thousand acres (about 5,500

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hectares), each plot of ten acres receiving the assignment to test five concentrations of the powder Nethoxone of 0.5 to 2 per cent. In 1945 ground chalk was being mixed with Nethoxone.

It was established that the loss suffered by many "resistant" annual and perennial weeds was so severe (serious) that their development and the maturing of seeds was disturbed. No after-effect was observed on wheat and oats. On barley physiological disturbances were noted in some instances which are being studied. Fertilizer distributors were used for spreading the powder. The increase in yield as the result of the application of Nethoxone has not been determined but "according to conservative estimates it represents an average of 30 per cent."

The substance of the problem under study hides possibilities of influencing the composition of the vegetation of natural meadows and, of course, the control of weeds in the fields in the fall, away from cultivated plants.

End of Article.

Literature: R. E. Slade, W. Y. Templeman, W. A. Sexton. Plant growth substances as selective weed killers. Nature, 3939, p. 497, April, 1945.

P. S. Nutman, H. G. Thornton. Inhibition of plant growth by 2:4 dichlorphototyacetic acid and other plant growth substances. Nature, 3939, p. 498, April, 1945.

G. E. Blackman. A comparison of certain plant growth substances with other selective herbicides. Nature, 3939, p. 500, April, 1945.

Britanskii Soiuznik (British Ally) 168, 28 October, 1945.

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(Transl. 80: Institutions)

Likhfel'd, I. G.
Rabota Vsesoiuznogo instituta rastenievodstva
v voennoe vremia.
[Work of the All-Union Institute of Plant Industry in wartime]
Vsesoiuzn. Inst. Rastenievod. Nauch. Otchet 1942: 6-17. 1945.
10C L541.

(Translated in part by S. N. Monson

From the day of the treacherous attack upon the Soviet Union by fascist Germany the work of the All-Union Institute of Plant Industry centered upon strengthening the direct support given the increase of resources of production and supplies of agricultural raw material within the country. In this connection a considerable part of the personnel of the Institute and its branches was assigned to collective and state farms for agricultural aid during sowing and harvesting periods.

With respect to the study and practical utilization of world collections of cultivated plants, attention was primarily devoted to producing the largest possibl amount of seeds of best regionalized or potential varieties grown or selected by th Institute from the above collections, as well as of varieties of which elite seeds had to be grown as part of an assignment placed by the Narkomzem of the Union. With respect to the greater part of crops the study of the collection was limited to the last stages of selection, i.e. the sowings of potential material for preliminary study and propagation, prior to its transfer to the Government network of Varietal Testing.

The course of war events radically changed the work of the main part of the Institute and that of its experimental bases distributed in the Leningrad region which in September 1941 found itself in the zone of direct warfare. A large part of physically capable staff members of the Institute participated directly, beginning July of that year, in the construction of defensive works on the approaches to Leningrad and within the city itself, while another group concentrated on research work of a specifically defense nature.

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In the fall of 1941 methods were developed in the chemical laboratory of the Institute for producing pharmaceutical tannin from extracts and leaves of Cotinus Mill, ("skumpia"), widely used in treating wounds. At one of the Leningrad plants where five staff members of the Institute were steadily engaged in work, the first production in the USSR of medical tannin was begun and its output reached such dimensions that it fully met the needs of the Leningrad front.

Upon a special assignment of the War Department the laboratory developed methods for coloring the tissues into khaki color using local vegetative dyes; these were subsequently transmitted to production and widely used by 1941. The work was performed by the joint staff of the laboratory under the guidance of Dr. P. A. Iakimov.

In connection with the critical food shortages in the blocaded city research of valuable nutritional elements was engaged in on food and industrial wastes and methods for their extraction were developed. This work was performed under the supervision of Dr. M. I. Kniaginichev.

On an assignment from war organizations the agro-meteorological department of the Institute, under the guidance of Professor G. T. Selianinov, did preliminary work on problems connected with the conduct of military operations and transportation during diverse weather and soil conditions.

At the Institute the work never stopped even during the most difficult days of the blocade when the supply of water and electricity gave out and the temperature in laboratories dropped to 15 - 20°. Just at that time considerable work was performed on preparing the most valuable part of the world collection of plants for transfer eastward and of the remaining part for prolonged storing.

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During the same period the staff of the Institute, under the guidance of the academician I. G. Eikhfeld, worked on the expansion of sowing areas of kok-saghyz, flax-"dolgunets," Linum indehiscent (Keilr.) Vav. et Ell., potatoes, medicinal plants, canned vegetables, melon, grain and leguminous crops, of which the main sowing areas were in regions already invaded by the enemy. In November-December, 1941 studies were made on the determination of agro-climatic possibilities for expanding sowing areas of the main technical and food plants in the Asiatic part of the USSR (Prof. G. T. Selianinov.) Data on the transfer East of sowings of food and technical crops was submitted in December to the Central Committee of the VKPb, the Gossplan and Narkomzem of the USSR for practical action. The proposed measures were subsequently carried out for many years in the Sverdlovsk oblast and at the Central Asiatic Experiment Station.

In connection with the conduct of military operations in the extreme northwestern USSR, the matter of transferring industrial plants East, and the overloaded transport situation, the problem of a food and forage supply base of our own in the extreme north and in the drought and desert regions of Kazakhstan and Turmenia became more real. The Polar and Pre-Aral Experiment Stations attempted to solve these problems, as did the Karabogazgolsk Base.

The Polar Experiment Station (director F. I. Man'kov and candidate P. A. Turnas) in 1941 - 1942 worked on the expansion of the sowing area and the increase of the yield of some crops at the Murman oblast close to the front line. Despite the proximity of the front, and difficulties experienced in labor and personnel shortage, the volume work at the Station and sowing areas increased, including that of propagated varietal material. The station organized its own seed production at the Murmansk oblast where it formerly had been hardly developed, except for few crops.

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In the spring of 1942 the station transferred 710 centners of seed potato for propagating to farms of Murmansk oblast, in addition to about 100 kg. of elite seeds of vegetable crops, 250 kg of elite seeds of forage crops and 42 centners of grain crops. The Murmansk oblast is at present the only one possessing sowing plots planted with potatoes of early, canker-resistant varieties, as a result of propagation of varieties produced by the station. Murmansk oblast may now be regarded as the main region capable of supplying varieties of canker-resistant potatoes and thus capable of aiding considerably in reconstructing a fence of plantings of canker-resistant varieties along the northwestern boundary.

The improved varieties of table sugar beet, "Egipetskaia 249" (Egyptian) and "Karmazinovy shar" 250, and the carrot variety "Early Horn" were regionalized in 1942 for six oblasts by the Government Commission on Varietal Testing of Legumes. In 1943 three new hybrid varieties of potatoes (Khibiny 3/70, Khibiny 11/12 and Khibiny 11/185) and two hybrid varieties of oats (Khibiny 01 and Khibiny 02) were transmitted to the Government network of varietal testing.

During the war period the station completed the development of a series of important agro-technical problems for pre-polar agriculture.

Lengthening of the field work season and of the vegetative period of agricultural crops is of great significance in the extreme north. The Station therefore developed particular measures for the Murmansk oblast for earlier than usual large scale snow removal by sowing in the spring pulverized by nepheline residues of the apatite industry which at the same time also serve as potash fertilizers. An earlier than usual snow removal permits starting field work 15 - 16 days earlier than usual and speeds up the ripening of grain crops by 7 to 8 days, as compared

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to customary periods. Considerable increases in yield were also obtained from this procedure, specifically, with regard to the hay "Timofeevka", [15.1 centners per hectare (32 percent) and seeds of 16.5 c/h (24 percent)].

In 1942 the Station grew 622 centners of elite seeds of various crops and stored 41 thousand seeds of vegetable crops.

It also provided agricultural technical service for collective and state farms and prepared and trained personnel for this work.

Staff Members of the Station worked in 1942 on the fourth edition of "Agro-directions for the Murmansk Oblast" applicable to war needs.

The Pre-Aral Experiment Station (director E. A. Maluigin) extended plant growing to desert and part-desert regions of Kazakhstan, where prior to the revolution agriculture had not been developed. In the zone serviced by the Station (Chelkarsk, Irgiz, Baiganin and Uilsk regions of the Aktubinsk oblast) sowing areas in 1942 amounted to 85,000 hectares, of which agricultural techniques developed by the Station were applied on 60,000 hectares and varieties planted recommended by the Station.

In 1942 the regional collective and state seed farms received 76 centners of seeds of grain and forage crops improved by selection, 35 centners of varietal potatoes, and 45,000 seedlings of different crops. The variety of millet "White Wales," improved by selection methods at the Station and outstanding from among the plantings of Chiganak Bersiev, a laborer decorated for the accomplishment, deserves special mention. On experimental fields of the Station and the irrigated fields of the collective farm "Jean Curliss" of the Irghiz region, it produced 184 centners

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of grain per hectare on a plot of 0.3 hectares and yielded 100 centners per hectare on a plot of 10 hectares. This variety is propagated with the view of covering all irrigated fields in the Chelkarsk and Irghiz regions with plantings of this millet by 1943. From its yield of 1941 the station transferred in 1942 130 centners of varietal seeds improved by selection for seed growing purposes.

The method of utilizing soft ground waters in trench cultivation of leguminous, developed by the station, became firmly rooted in the Aktubinsk oblast where the general spread of trenches was 20 km. Methods for ensuring moisture plantings in the desert were widely introduced; of these the most important method is the sorghum link fallow.(??) which increases the yield of millet 4 times, compared to the usual black fallow, as well as snow retention by a tall stubble of the predecessor crop.

Under the guidance of the personnel of the station 56,600 hectares of grain and forage crops were planted in the spring of 1942. During the winter months 802 men were trained for work at courses organized at the Station.

KARABOGAZGOLSK BASE between 1941 - 1942 established its own leguminous fields (base) at the industrial zone of the Pre-Caspian desert. Under its supervision supplementary farms of industrial enterprises were set up which grew leguminous and melon crops by agricultural trench method, developed at the above base for conditions of the Pre-Caspian desert. The total length of trenches on farms was 38 km in 1942. The base selected varieties suitable for trench agriculture, among which the well known "Erbent" watermelons and melons deserve particular attention, since they produce high yields under trench cultivation.

THE CENTRAL ASIATIC EXPERIMENT STATION directed by the Govt...of the Uzbek SSR,

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conducted together with the Uzbek branch a vast amount of work on regionalizing agricultural crops (N. V. Kultiasov, doctor K. I. Pangalo, and F. S. Ventslavovich) by introducing new crops in Central Asia and developing methods designed to increase the yield of grain, leguminous and oil crops.

In the Namangan, Andizhan and Ferghan oblasts, aided by the Varietal Seed Vegetable Institution, work proceeded on seed growing of vegetable crops for canning to compensate for losses connected with the temporary occupation of regions where the latter crops were formerly grown (peppers, eggplants, tomatoes, carrots) and seed growing of the best local varieties. Aided by the All-Union Institute of Genetics and Selection agro-technical research is conducted on sugar beet and its varieties studied with respect to conditions of Central Asia.

The best varieties for Uzbekistan, of the most important food and technical crops, i.e.... grain, leguminous, oil and melon crops, of which elite seeds are grown at the Station, are developed there. Among these are several crops grown only from products of elite seeds produced at the Station.

In connection with extending sowing areas under grain-leguminous and cereal crops at Uzbekistan, the Station increased the production of elite seeds of these particular crops.

(Omitted reference to leguminous, melon, cotton, oil and other crops.) p.9,10.

MAIKOP EXPERIMENT STATION intensified during the war its work in fields which compensated Krasnodar and Ordzhokinidze Territories for their losses of legumes for canning and seeds of sugar beet and fruit crops for the Ukraine and Crimea regions. (Omitted paragraphs on sugar beet growing and new varieties of this crop and their respective yields, p. 10 and 11.)

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TURKMEN AND FAR-EAST EXPERIMENT STATIONS also intensified their work on fruit crops and viniculture. (Omitted, part of p. 11).

KUBAN EXPERIMENT STATION conducted before the war a great deal of work on field crops. Throughout the war it concentrated on introducing into production methods intended to increase the yields of maize, grain crops and root caoutchouk crops at Krasnodar and Ordzhinikidze Territories, as well as growing of varietal seeds.

In 1942 73.25 hectares (10 crops, 22 varieties) were occupied under elite seed sowings of grain, leguminous, corn (Maize), sorghum, millet and forage grasses. The plan of growing elite seeds contemplates not only to fulfill the assignment of the Narkomzem of the USSR with respect to the Northern Caucasus, but also to produce a surplus of seeds for those oblasts where because of war activities seed growing had been interrupted. Plantings in excess of the plan amounted to 21.7 hectares in oil flax, 7.6 hectares in chick peas for canning, etc.

DERBENT EXPERIMENT BASE served before the war as the main experiment base for the study and preservation of the World's Collection of Wheats in a live state. In recent years the base was also given the task of seed growing, and upon the order of the Glavsortupr (Main Varietal Administration) of the Narkomzem it developed elite seeds of hard winter wheat and barley selected from domestic varieties. In 1942 the base grew elite seeds of wheats on 19 hectares, barley on 3 hectares, obtaining 98 centners of elite seeds. The local varieties of hard winter wheat Ak-Bugda (mixture of various species) and Sara-Bugda (Gordeiform of Selection 1940), produced at the station and introduced into production by the latter proved of highest yield at collective farms and plots of the Goscommission on varietal testing. In 1942 the Base transferred to the Government Network of Varietal Testing 4 new

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varieties of winter wheat, selected from local populations, for the low and pre-mountainous regions (510 Apulikum, 520 Gordeiform, 196 Pseudo Barbarossa, 648 Eritrospermum) and two varieties selected from varieties of foreign selection (Czechoslovakia - Nigroaristatum and Sudan - Gordeiform). In addition, several new varieties of local wheat were selected by individual mass methods which are undergoing tests at the station.

Based on the vast material accumulated at Dagestan, the supervisor of the Base, candidate of biological sciences, T. K. Pnin, wrote a book on "Cereal Crops and Grain-Leguminous in the Fields of Daghestan."

The Main Section of the Institute was operating at Sverdlovsk oblast, Ural, beginning spring of 1942. (See article/translated on work performed there during the occupation of Leningrad ....

In Sverdlovsk oblast, for instance, the area planted under potatoes and legumes increased more than twice and the cultivation of leguminous was for the first time transferred from suburban gardens into the fields. In connection with handicaps which interfered with seed growing of clover in western zones, Ural regions were also required to grow clover seeds.

The development of the young fruit and berry culture in the Ural, the supplies of which had been cut off from the south, was also intensified.

Thus the primary tasks of the Ural Section of the Institute in war time was to develop measures for the rapid expansion of sowing areas, the raising of potato and legumes yields in the Ural, the increase of yields of seeds and red clover, as well as the study of conditions for developing fruit and berry culture at Sverdlovsk oblast (Ural).

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In 1942 the Institute created its own leguminous-potato base at the Sverdlovsk suburban zone which covered the needs of 10 administrative regions.

This work was conducted by the Institute jointly with the Commission on the mobilization of resources of the Ural of the Academy of Science of the USSR for needs of defense and the benefit of local experiment institutions. The personnel of the Academy engaged in economic and soil research, while the staff of the Institute worked on agro-meteorological and agronomic research; the work was conducted by regional units in groups (detachments), although because of transport difficulties it was not always possible to make use of this practice.

Agro-meteorologists completed a description of climatic resources of the Ural and composed an agro-climatic map (Sapozhnikov, S. A., candidate of geographical science). Research done during expeditions on the development of heat-loving vegetables for the Central Ural section specifically dealt with micro-climatic peculiarities of individual regions (Prof. G. T. Selianinov) and the problem of ensuring moisture to leguminous crops (A. N. Alpat'ev).

Plant growers studied conditions of producing vegetables and potatoes in the south-western parts of the Pre-Ural region in detail and tested the principal recommended methods at collective farms. The Central mountain-industrial regions were also included in this research, as was the production of vegetables and potatoes at the largest suburban vegetable state farms. (V. F. Krasochkin and T. V. Lizgunova).

Towards the end of 1942 a report concerning the principal measures for developing sowing areas and increasing yields of vegetables and potatoes in the mountain-industrial region of the Central Ural during the war years was submitted. Lysenko, President of the All-Union Academy of Agricultural Sciences directed the Institute

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to supervise the storing and utilization of potato tops for seeding purposes at Sverdlovsk oblast.

As seen from the observations and records of industrial plantings in 1942, the utilization of potato tops in the Ural served not only as a measure to increase stored supplies of seed material intended to enlarge sowing areas, but at Sverdlovsk oblast, which possessed limited amounts of good varietal potato and where because of the lack of well organized seed-growing, small-size potatoes affected by disease were obtained, the planting of potato tops served as the principal method for increasing the seed quality of potatoes. Tops are usually cut off from large and medium tubers and not from small, degenerated tubers; on individual laborers' gardens, however, the latter kind usually served as the main seed material. The utilization of tops permitted speedier propagation of the few available varieties of high yield, such Majestic, Kalev, etc. Sverdlovsk oblast was also confronted with a critical seed shortage of vegetable crops, the latter production not being developed; nor had conditions for growing seeds had also not been studied.

Scientific guidance over the organization of vegetable seed growing on the Ural was also included into the plan of the Institute for 1943. In 1942 members of the Institute, T. V. Lizgunova and V. T. Krasochkin and N. A. Shebalin, supervised the production of vegetables and seed growing of vegetable, forage, and root crops in the south-western regions of Sverdlovsk oblast. Five million seeds were stored at the collective farms of these regions in the fall of that year.

Studies of climate and agro-technical conditions for developing sowing areas of potatoes and vegetables in the Northern Ural are planned for the future. Among other crops are sugar beets, sunflower and melons for Bashkiria, Cheliabinsk and Chkalov oblasts.

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To aid the rapid reconstruction of seed growing of vegetable plants in the Leningrad oblast and adjoining oblasts and republics, the Institute began in 1942 to propagate vegetable crops of its own selection and those of the Leningrad zonal vegetable experiment station located in the Krasnoufim region, Sverdlovsk oblast. In the fall the Institute stored 61,750 seeds of cabbage, turnip, carrots, sugar beets, and other crops.

The Ural is one of the principal and oldest regions where clover was sowed. The well known "Perm clover" is successfully grown throughout the northern belt of the European part of the USSR. Clover growing in the Ural region at present is however in a far from satisfactory state and plans for seed storing are not fulfilled year-in year-out. (Omitted further information on clover, fruit and berry growing in Sverdlovsk oblast., p. 15 and part of 16).

Another accomplishment of Union significance performed by the Ural group of the Institute concerns the development of measures for storing and speeding up the propagation of canker resistant potatoes, the propagation of varieties of kok-saghyz of the Institute's selection, and the search for new sources of tannin raw plant material.

Data was submitted to the Narkomzem of the USSR for the preservation and propagation of canker-resistant varieties of potatoes, essential for the reconstruction of a fence along the Western boundaries of the USSR. Canker-resistant varieties of potatoes are at present introduced in oblasts and republics of the USSR and measures undertaken for their more rapid propagation. (Dr. S. M. Bukasov). The forced propagation of a selection of the most valuable varieties is conducted by the Polar Experiment Station of the Institute, (Sverdlovsk oblast) and at suburban state farms of Leningrad.

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The Bio-chemical Laboratory of the Institute (N. B. Koialovich) developed methods for the quantitative and qualitative evaluation of caoutchouk in roots of kok-saghyz, as well as methods developed for extracting caoutchouk from roots by boiling it in water and treating it on wooden graters.

During the war the demand for tannic substances and medicinal tannin increased considerably, since these were formerly imported from abroad. Our own sources of raw material were lost in the south of the Union during the war. In searching for new sources of supply of tannic substances, the wild flora of the Ural was studied. Large quantities of plants containing tannic substances were found. Of most practical significance were the large roots of Polygonum L. of the Polygonaceae family. Dried roots of the plant contain in the fall from 23-24 percent of tannin; the better kinds up to 60 percent. Methods were developed to refine the roots and prepare tannic liquids. Tannic extracts are also used in the leather industry.

The personnel of the Institute participated in the agricultural service rendered to five regions of Sverdlovsk oblast, primarily in producing vegetables, potatoes and seed growing. Twelve courses and seminars were organized for agronomists, brigade and link leaders, and a total of 280 people were trained. In addition, the personnel of the Institute participated in 15 instructive conferences at oblast and regional organizations. The staff is preparing for publication 5 handbooks on seed growing, agricultural techniques and plant protection from pests.

A group of Leningrad staff members preserved the world collection of cultivated plants under the hardships of a besieged city and supplied the needs of suburban farms.

The entire collection is in a satisfactory condition; the selected collection

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of potatoes of canker-resistant varieties was planted by staff members on a plot of 2 hectares in two suburban farms and further propagated.

Following the proposal of Leningrad organizations, the Institute planted a plot in the suburban zone for agricultural service to industry. Here about 400,000 seedlings were grown for substitute farms.

In the spring staff members of the Institute conducted courses and seminars at four points for brigade leaders, vegetable growers, and arranged for study groups with directors of substitute farms. Definite farms were assigned to staff members for systematic agricultural service and several of these farms earned the distinction of being awarded the transitory Red Banner.

The All-Union Institute of Plant Industry intensified the extension of practical aid to agriculture during the war years and broadened the scope of its work by including new regions and creating new problems.

End of Chapter.

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Gusev, V. I.
The new structure of the Scientific Soviet of VIZR (All-Union Institute of Plant Protection).
Vest. Zashch. Rast. 1939(1): 133-134. 1939. 421 P942

Translated by R. Dembo

(Transl. 81: Institutions)

By decision of the Presidium of the Academy of Agricultural Sciences of Lenin of December 26, 1939, the Scientific Soviet is accepted in the following structure: I. P. Elsukov - Director of VIZR, the president of the Scientific Soviet; I. M. Poliakov - Assistant Director of VIZR along scientific lines, vice-president of the Scientific Soviet; candidate of agricultural sciences B. I. Gusev - the scientific-secretary of Scientific Soviet; and members of the Scientific Soviet: academician N. M. Kulagin, academician V. P. Pospelov, academician N. I. Vavilov, member-correspondent of the Academy of Sciences M. M. Rimsky-Korsakov; doctors: V. N. Stark, IA. I. Prints; I. V. Vasiliev, N. F. Meier, D. E. Belenkii, N. N. Bogdanov-Katkov, N. A. Naumov, V. N. Shchegolev, M. S. Tunin, N. N. Archangelskii, S. A. Predtechenskii, Professor I. P. Iatsenko; candidates of agricultural sciences S. M. Tupenevich, B. IU. Falkenstein, G. K. Piatnitski, T. I. Fedotova, N. S. Fedorinchik, V. F. Lapina, A. P. Ostapets, K. M. Stepanov, E. V. Koshkin, I. M. Zambin, K. P. Kuznetsov; older scientific co-workers: D. M. Paikin, A. N. Kasikhin, P. N. Polzik, P. V. Sazonov, I. G. Chaiko, F. E. Pushin, IA. A. Meisakhovich, B. A. Dodonov; director of Rostov Stazra S. IA. Borover; director of Moscow Stazra A. K. Danilov; collective-farmer-experimenters: I. A. Kikot' from district of Kamensk of Kirovograd region and Smorodin from the district of Cherepovetsk of the region of Vologda, and also agronomist of Oblzo S. M. Volkov.

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Meier, F. F. (Transl. 82: Institutions)
List of topics recommended for scientific research work in republic, oblast, and regional laboratories of biological methods.
Zashch. Rast. 17:143. 1958. 421 P842. Translated by R. Dembo

1. Hatching of local races of trichogramma from winter crop owlet moth [Agrotis segetum Schiff], cotton owlet moth [corn earworm, Chloridea obsoleta F.], cabbage owlet moth [Barathra brassicae F.], meadow moth [Loxostege sticticalis Z.], corn moth [European Corn borer, Pyrausta nubialis Hb.], apple fruit eater [codling moth, Laspeyresia pomonella L.], plum fruit eater [Laspeyresia funebrana F.] and cluster leaf roller [grape berry moth, Polychrosis botrana] with the purpose of explaining their relative effectiveness.

The work is carried out through the productive application of trichogramma: parasites are used which are obtained from the eggs of the pests collected for the analysis depending on the availability of local eggeaters. Experiments for the comparison of the effectiveness of various races of trichogramma are carried out with the observance of similar conditions.

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2. The working out of the possibility of replacement of wheat by other grain crops for the controlling mass propagation of the grain moth.

3. The working out of measures for controlling flour tick [Tyroglyphus farinae L.], particularly by means of applying washing-powder recommended by the Laboratory of Biological methods LenStazra (Lenin Station for Plant Protection) and of calcium hydroxide, "pushonka."

4. Estimation of the capacity and flight distance and also determination of the ways of settling grain moth [Sitotroga cerealella Oliv.].

5. Working out of measures of controlling the paunchy mite [Pediculoides ventricosus].

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Comparison of the effectiveness of methods of releasing the trichogramma in mature stage and by means of hatching the trichogramma in the eggs of grain moth, [angoumois grain moth, Sitotroga cerealella Oliv.].

Laboratories that undertake the execution of any topic having methodological difficulties may address for consultation the Laboratory of Biological Method VIZR (All-Union Institute for Plant Protection).

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(Transl. 83: Plant Protection)

Leningrad Institute Zashch. Rast.
Svodnyi plan po zashchite rastenii na 1935.
(Summarized plan for work in plant protection during 1935).
1935. 464.4L54

Translated by S. N. Monson

INTRODUCTION

One of the most important shortcomings in the organization of scientific research in the field of plant protection is the lack of contact between separate scientific institutions and individual workers and the lack of information concerning research conducted throughout the Union.

In order to eliminate this fundamental deficiency the All-Union Institute of Plant Protection decided to publish its plans, beginning 1935, as well as the plans of other scientific research institutes for the benefit of the rest of scientific research institutes, as well as of the VUZY (higher institutes of learning). Despite our requests to send in plans of uniform aspects, as submitted in our sample forms, the plans arrived in the most diverse styles; some expressed in extremely general terms, others going into great detail. We were therefore obliged to settle upon the briefest form of plan listing only subjects, and wherever possible the personnel dealing with them and indicating in addition the periods in which the work was performed.

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It is imperative that all institutions conducting scientific research on plant protection send in to VIZRa their statements concerning their summarized plans for 1936 and also submit the actual plan of work for 1936 no later than by March, 1936, considering that it is absolutely essential for the summarized plan to be published by April 1, 1936.

The present plan is forwarded to all interested scientific research organizations and practical institutions.

I. A. Zelenukhin, Director of VIZRa.

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SCIENTIFIC RESEARCH INSTITUTIONS

AGMI .....Scientific Research Institute of Areal Hydro-Meteorology

AzSTAZRA .....Azerbaidjan Station of Plant Protection

BIN .....Botanical Garden of Academy of Science of the USSR

VNIISKHA .....All-Union Scientific Research Institute of Agricultural Aviation

VIZRa .....All-Union Institute of Plant Protection

VIR .....All-Union Institute of Plant Industry

VNIKO .....All-Union Scientific Research Institute of Hemp

GIPKH .....Government Institute of Applied Chemistry

Zak.NIKHI .....Transcaucasian Scientific Research Cotton Institute

ZIN .....Zoological Institute of Academy of Science of USSR

Vor. STARZA .....Voronezh Station of Plant Protection

MGU .....Moscow Government University

MosSTARZA .....Moscow Station of Plant Protection

Nov. NIKHI .....Scientific Research Cotton Institute in new regions.

n/p .....observation point of Statistical Record Service of All-Union Institute of Plant Protection

OZRA .....Department of Plant Protection

OMVIZR .....Department of Mechanization of All-Union Institute of Plant Protection

SPI .....Northern Fruit Institute

IUPI .....Southern Fruit Institute

Sr-AS.NIKHI .....Central Asiatic Scientific Research Cotton Institute

STAZRA .....Station of Plant Protection

SU .....Statistical Record Service of All-Union Institute of Plant Protection

SUR .....Sector of Statistical Record Service and Regionalization of Institute of Plant Protection

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Leningrad Institute Zashch. Rast.

EXPLANATORY NOTE TO THE PLAN ON THE SUBJECT MATTER OF SCIENTIFIC RESEARCH OF VIZRa FOR 1935

I. The principal inadequacy in plans of VIZRa in previous years consisted in the diversity of subject matter and its disconnectedness, and the lack of leading work problems essential in solving the principal tasks in the field of plant protection. The subject matter of the Institute was in the past not connected in content with the work and tasks of branch institutes.

The principal aims of the Institute consisted primarily in biological and ecological studies of multi-poisonous pests and diseases and the development of measures to control them; the search for new poisons, the widening of the circle of the application of old insecto-fungicides, and the construction of machinery.

These tasks were performed without necessary theoretical basis. VIZRa did not place the theoretical generalization of its practical experience and that of other scientific institutions upon a serious basis.

II. The plan of 1935 proposes to eliminate the principal inadequacies and to concentrate the main strength and resources of the Institute upon solving the most important problems connected with plant protection. These are:

1. Ecological-economic regionalization of the territory of the Union with regard to distribution of pests and diseases, in order to plan individual methods for controlling pests and diseases; the organization of scientific research at VIZRa and the network of branch institutes.

2. Study of factors limiting and contributing to the mass appearance of pests and diseases with the view of making theoretical prognoses for agro-technical and biological measures in the control of pests.

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3. Theoretical research in chemical control; determination of types of machinery for different branches in agriculture. In this field VIZRa plans to study new chemicals to substitute for the deficit chemicals, i.e. copper, arsenic and formalin.

4. The scientific establishment and development of a system of practical measures designed to give protection from pests and diseases of crops in rotation. The plan of 1935 proposes to change from the development of measures that apply to individual pests and diseases to the introduction of results of their studies in the above three fields and within the network of research institutions, with the view of building up an over-all system of measures directed against pests and diseases of grain and cotton farms.

III. Aside from the leading subject matter, the plan of VIZRa of 1935 includes the following problems of great economic public significance:

1. The necessity for determining measures to ensure the protection of yields is taken into account in the transfer of grain crops to [illegible] soils of the north and east, (cleaning brush, draining swamps, plowing of virgin steppe, and irrigation of the Zavolzhie). In this connection the study of the biocenosis of wild lands is included which will eventually provide a prognosis on pests and diseases and establish a system of measures for the early periods of their use under agricultural crops.

2. The creation of shelter forest belts in the drought zone of grain farms compelled VIZRa to include into the plan of 1935 the study of the biocenosis of these belts, so as to establish a system of measures designed to protect plantings in the belts themselves, as well as for the purpose of studying them as reserve

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territories in the control of agricultural pests and diseases.

3. In connection with the necessity of establishing the immunity of grain crops with respect to fungus diseases. in selection, VIZRa included the study of races of rust and smut into the plan of 1935.

4. In considering the development of sub-tropical farming, VIZRa included into its plan the most dangerous pest, the San Jose scale.

5. In order to assimilate collected data of former years, to organize it systematically and prepare it for maximal use and transmittance to industry, VIZRa devised the plan to produce monographs and summaries devoted to individual pests and diseases and prepare a synthesis of world and Soviet Union experience.

6. To ensure uniformity and coordination in the work of VIZRa, its branch institutes and network, the plan will include supervision over the work of the periphery of branch institutes, call conferences devoted to plans on subject matter, arrange instructive excursions, prepare summarized plans on research on plant protection for the entire Soviet Union.

7. The plan for 1935 envisages the considerable intensification of work by VIZRa with regard to the transfer of its achievements to industrial production by the organization of laboratories of production on location, at cottage laboratories, state farms and MTS, where tests of new achievements may be made under conditions of agricultural production, and the experience of advanced state and collective farms in the field of plant protection get generally coordinated.

The plan of VIZRa shapes up as follows:

SECTION I. Supervisory work of the Institute with respect to the periphery

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and network of branch institutes;

SECTION II. Scientific Research at the Institute;

SECTION III. Coordination of the experience of VIZRa and the network of scientific research institutions on plant protection in the USSR and abroad;

SECTION IV. Transfer into agricultural practice of scientific achievements in the field of plant protection.

End.

(Continued on p. 6)

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SECTION I

PLAN FOR INSTITUTE'S GUIDANCE EXTENDED TO ITS PERIPHERY AND THE NETWORK OF BRANCH INSTITUTES

Nos. in their order	Project	Participants	Person in Charge	Date
1	Receipt of plans of all scientific-research institutions on plant protection; compilation and publication of summarized plan of work for the Union for 1935.	All departments of protection of branch institutes and all Stations of Plant Protection.	Prof. V. N. Stark	May 15
2	Conference at Tiflis to coordinate experience and prepare program for research for 1935 on oil residues and emulsions.	Asiatic Black Sea, Azerbaidjan, Armenian, Georgian and Central Asiatic STAZRA (Stations) NIUIF, Asnepht', Narkomzem of Trans-Caucasian Republics	Prof. B. N. Dashkevich	January
3	Conference at Kharkov to coordinate experience and develop program for 1935 on virus diseases.	VIZRa, Institutes of Cotton, Grain, Legumes and Sugar Beet; Ukrainian, Crimean and Asiatic-Black Sea STAZRA; Narkomzems of RSFSR, Ukraine and Crimea.	Prof. V. L. Fyzhkov	End of February
4	Conference at Rostov-on-the Don to coordinate experience and develop program for 1935 on hydrogen sulfide.	Glavkhimprom, Main Institute of Chemistry, Institute of Aluminum, Main Administration of MKZ USSR, MKZ RSFSR, Stations of Plant Protection of Azov-Black Sea, Azerbaidjan, Ukraine and Central Asia; branch institutes of grain, cotton and sugar beet.	Prof. N. N. Arkhangelskii	Early March

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Nos. in their order	Project	Participants	Person in Charge	Date
5	Workers' Conference at Voronezh to deal with problems of instruction of organizations participating in developing measures for protecting grain industry from pests and diseases.	Main Grain Administration of NKZ USSR, Grain Institute, Voronezh STAZRA, points of Statistical Record Service: Shatilov, Bezenchuk and Anuchin.	A. V. Znamenskii, specialist in science	April
6	Workers' Conference at Tashkent for the instruction of organizations participating in measures to protect cotton from pests and diseases.	Central-Asiatic and Azerbaidjan STAZRA, Institute of Cotton; observation points of Statistical Record Service of Uzbekistan.	V. V. Nikolskii, specialist in science	March
7	Workers' Conference for the revision of existing instructions of VIZRa and the introduction of necessary corrections.	Principal Administrations of NKZ of USSR, Institutes of Grain, Cotton, Sugar Beet, Legumes, Fruit and Berry crops, Flax, Hemp, etc.	V. F. Volkov	October
8	Guidance Conference to deal with measures developed for the control and plan for 1935 of research on rodents in special regions of Azov-Black Sea, Northern Caucasus, and Stalingrad territories.	Territorial Soil Administration (KraiZU), Institutes of Microbiology of Azov-Black Sea, Northern Caucasus and Saratov; Institute of Zoology of MGU, etc.	S. I. Obolenskii, Specialist in science	Early February
9	Compilation and publication of handbook on methods of laboratory-experimental ento-ecological research.	Ecological Laboratory VIZRa.	I. V. Kozhanchikov, sr. specialist in science	Early February
10	Compilation and publication of handbook on experimental phyto-pathological research.	Phytopathological sector of VIZRa	T. I. Fedotova, specialist in science	December, 1935

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Nos. in their order	Project	Participants	Person in Charge	Date
11	Compilation and publication of handbook on methods and technique of recording losses of crops from rust, Agrotis segetum Schiff., Sciuridae, mildew, oidium, and diseases of flax and pests of Crucoferae.	Brigade of VIZRa	Prof. A. A. Luibishchev	April 1, 1936
12	Compilation and publication of handbook on recording efficacy of measures in controlling pests and diseases.	Brigade of VIZRa, Central Asiatic, Leningrad and Crimean STAZRA, observation points of Statistical Record Service.	Docent F. S. Pervukhin	April 1, 1936
13	Compilation and publication of instruction on recording pests and underground diseases of leguminous crops and soil pests.	Branch sectors of VIZRa, network of observation points of Statistical Record Service, STAZRA, and branch Institutes of Legumes and Grain Industries.	V. F. Volkov	December, 1935
14	Systematic Guidance extended to observation points on Statistical Record Service by presenting plans of work, arranging for consultations on use of instructions, the analysis of incoming material and directions concerning it.	Branch sectors of VIZRa, Grain Industry, Cotton, Sugar Beet and Legumes and Woody plants.	G. M. Iaroslavtsev, P. A. Proida, B. U. Falkenstein	Entire Year
15	Continuous guidance of work of branch institutes and Stations of Plant Protection on matters connected with planning and research; consultations on inquiries, trips to locations, temporary assignments to laboratories and libraries of the Institute.	Grain Industry	A. V. Znamenskii, specialist in science	Entire Year
		Cotton, flax and hemp industries.	Prof. V. N. Shchegolev and V. V. Nikolskii	"
		Sugar beet and Legumes.	I. V. Nikitin, specialist in science	"
		Woody crops (plants)	Prof. V. N. Stark and Ia. I. Prince, specialist in science	"

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Nos. in their order	Project	Participants	Person in Charge	Date
15 (cont'd.)		Chemization	Prof. B. N. Dashkevich	Entire Year
		Mechanization	Engineers I. P. Iatsenko and Snigur	"
		General problems of entomology	Prof. V. P. Pospelov	
		General problems of phytopathology.	Prof. M. A. Naumov	
		Problems of parasitology.	Prof. N. F. Meyer	

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SECTION II

SCIENTIFIC RESEARCH WORK OF INSTITUTE

1. ECOLOGICAL ECONOMIC REGIONALIZATION OF USSR WITH RESPECT TO PESTS AND DISEASES.

BASIS. Regionalization is necessitated by the demand of a basis for planning and the organization of operational work and systems of methods.

ANTICIPATED RESULT IN 1935. Development of methods on ecological-economic regionalization of the Union with respect to the following primary objects:

Cutworm moths (Agrotis Segetum Schiff.), ("ozimaia sovka"); responsible worker Nikitin;

Meadow moth (?), Loxostege sticticalis L. ("lugovoi motylek"); Znamenski;

Corn borer ("kukuruzny motylek"), Shchegolev;

Asiatic locust, Predtechenskii;

Marocco locust (Dociostaurus maroccanus Thnbg.)

and grasshopper, (Caliptamus italicus L.) ("prus") Bei-Bienko and Chetyrkina;

wireworms, Iaroslavtsev;

Limacidae, slugs, ("slizni"), Grivanov;

Hessen and Swedish flies, Znamenski and Karpova;

may beetle ("maiskii khrushch") Berezina and Stark;

leaf roller moth, ("Graptalitha) ("plodozhorka"), Aristov;

brown-tail moth, (Nygmia phaeorrhea Don.) ("zlatoguzka"), Avdeeva;

pierid butterfly, (Aporia crataegi L.) ("boiaryshnitza"), Aristov;

San Jose scale (Californian Shchitovka"), Popova;

cabbage butterfly, (Hylemya floralis Fall.) ("kapustnaia mukha"), Lakhimovich;

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smut of rye, Proida and Markhaseva;

loose smut of cereals, Proida and Markhaseva;

rust of cereals, Kotova;

rust of flax, Nesterova;

gummosis of cotton; Letov;

Citellus-gopher, Suslik, Falkenstein.

Method of Work: Ecological-economic analysis, material of S.U.R. (Statistical Record Service), network of branch institutes and STAZRa, ZIN, and practical summarized data of brigades and laboratories of Institute. Literary summary. Analytical preparation of material and its collection through SUR. The organization of a working office on regionalization. Special conference on work approval.

Responsible brigade leader on the subject: Dr. V. N. Shchegolev. Participating in the work will be the following organizations: AGNI, ZIN, STAZRA, OZRASI, VIR, BIN. The work will be approved from the standpoint of method by the Office of Regionalization of VIZRa.

Period: To start in 1935, to end in 1937.

2. STUDY OF PHYSICAL AND BIOLOGICAL FACTORS OF MASS PROPAGATION AND DISTRIBUTION OF PESTS FOR THE PURPOSE OF ESTABLISHING REGULARITY OF MASS PROPAGATION AND PROGNOSIS.

BASIS: The purpose of the work is to study regularities in mass propagation and the distribution of pests based on the analysis of the influence external factors have upon the development of insects, as well as the reaction of the organism upon this development.

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ANTICIPATED RESULT IN 1935. Compilation of thermohygrogram (?) of Loxostege sticticalis L. ("lugovoi motylek") and Agrotis segetum Schiff. ("ozimaia sovka"). Exposure of frost resistance of Agrotis-gamma, Loxostege sticticalis L. and Agrotis segetum Schiff.

Compilation of thermohygrogram on corn borer. Relative to Aspidiotus perniciosus Comst., study of frost resistance and compilation of thermohygrogram.

Section 1. Study of influence of temperature and moisture upon the development of caterpillars of Loxostege sticticalis L. ("lugovoi motylek") and Agrotis segetum Schiff ("ozimaia sovka").

Method of Work: Training under laboratory conditions at temperatures of 14, 20, 24, 26, 30 and 32°C.

Experimentors: Kozhanchikov, specialist in science, laboratory asst. Dianova, technician Kachevskaia.

Period: January to December, 1935

Section 2. Influence of temperature upon the development of caterpillars of corn borer.

Method of Work: Training under laboratory conditions at temperatures of 10, 35°C.

Experimentors: Kozhanchikov; laboratory asst. Nuzhdina.

Period: June to December, 1935

Section 3. Frost resistance of caterpillars of Agrotis gamma.

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Method of Work: Galvano-metric and cryohydrate equipment.

Experimentor: Dobretsov, specialist in science.

Period: May-December, 1935.

Section 4. Influence of qualitative changes of nutrition upon the diapause of Loxostege sticticalis L. ("lugovoi motylek").

Method of Work: Study of growth under temperatures of 5, 10, 20°C, under constant light.

Experimentors: Kaminskii and temporary technician.

Period: April to December, 1935

Section 5. Histological study of changes of fat body (?) ("zhirovoe telo") of corn borer and Loxostege sticticalis L. under different temperature and moisture conditions.

Method of Work: Fixation and histological working over of material.

Experimentors: Larchenko, sr. specialist in science, technician Kantsevich, and Prince, specialist in science.

Section 6. Influence of meteorological factors and nutrition upon the development and fertility of Polychrosis botrana Schiff. ("grozdevaia listovertka").

Method of Work: Thermostat work on microclimate in vineyard.

Experimentors: Prince, specialist in science and temporary assistants.

Section 7. Influence of meteorological factors and soil dynamics upon the development of Melolontha melolontha/("maiskii khrushch").
May beetle

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Method of Work: Soil excavations and use of microclimatic laboratory equipment; training in lysimeters.

Experimentors: Prince, Kosmachevskii, laboratory asst. Babinskaia.

Period: April to December, 1935

Section 8. Study of movements of larvae of wireworms and development of methods to train wireworms under laboratory conditions.

Method of Work: Field observations with registration of temperature and moisture; training in lysimeters.

Experimentors: Babinskaia, temporary laboratory asst. and Sector of Grain Crops.

Period: June to December, 1935

Section 9. Frost resistance and influence of high temperatures upon harmful Aspidiotus perniciosus Comst; San Jose Scale, ("shchitovka").

Method of Work: Use of galvanometric and cryohydrate equipment.

Experimentors: Popova, specialist in science and temporary technician.

Period: February to December, 1935

Responsible brigade leader on the subject: Ia. I. Prince, specialist in science.

Period: Began work in 1931. Subject transitory.

3. STUDY OF PHYSICAL AND BIOLOGICAL FACTORS OF MASS PROPAGATION AND SPREAD OF DISEASES TO ASCERTAIN REGULARITY IN MASS PROPAGATION AND ESTABLISH PROGNOSIS.

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BASIS. The object of the work is to study regularities in mass propagation and spread of diseases, based on analysis of influence external factors have on the development of fungus and the reaction of the organism to their development.

ANTICIPATED RESULT IN 1935. Compilation of nomogram of the appearance and propagation of diseases named below.

Section 1. Influence of climatic conditions upon the development of phytophora of potatoes.

Method of Work: Scientific processing ("Kameralnaia") of data of field observations over a period of many years.

Experimentor: Naumova, N. A., senior specialist in science.

Period: January to December 1935

Section 2. Regularity in the development of yellow rust of wheat, dependent upon meteorological conditions.

Method of Work: Experiments at nurseries; field observations and statistical recording.

Experimentors: Naumova, N. A., sr. specialist in science.

Period: January to December, 1935.

Section 3. Regularity of development of crown rust of oats dependent upon meteorological conditions.

Method of Work: Experiments at nurseries; field observations and statistical recording.

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Experimentors: Parland, A. G., sr. specialist in science, Kuprianova, V. I., laboratory asst.

Period: January to December, 1935.

Section 4. Study of regularities of development and the epiphytes of apple scab, dependent upon seasonal variations in the weather and the nature of primary infection.

Method of Work: Scientific processing of available data on the development of diseases and weather conditions.

Experimentor: Stepanov, K. M., sr. specialist in science

Period: January to December, 1935.

Section 5. Influence of temperature and moisture of air upon the infection of wheat by smut (Ustilago)

Method of Work: Experimentation in thermo-chambers

Experimentor: Position vacant

Period: May to December, 1935.

Section 6. Establishment of boundaries of sources of infection of harmful effect, depending upon the degree of their vigor and ecological conditions (rust).

Method of Work: Field experiments, observations and statistical recording.

Experimentor: Stepanov, K. M. and network of observation points of SUR.

Period: January to December, 1935.

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Section 7. Development of methods for regulating the climate in nurseries on the basis of regularities in the development of plant diseases.

Method of Work: Experiments in multiple thermostats, nurseries and hothouses. Statistical recording and observations.

Experimentor: aspirant Kalashnikov, K. Ia.

Period: January to December, 1935.

Section 8. Bio-ecology of cabbage club root ("kila"). (Plasmodiophora brassicae Wor.)

Method of Work: Experimentation at laboratory and nursery.

Experimentor: Aspirant Fedorinchik, N. S.

Period: January to October, 1935.

Responsible brigade leader on the subject: Stepanov, K. M., sr. specialist in science.

Experimentors: VIZRa, Institute of Potato Industry, Voronezh STAZRA.

Period: Work begun in 1934. Subject transitory, perennial.

4. STUDY OF COMPOSITION AND DYNAMICS OF BIOCOENOSES OF WILD AND NEWLY RECLAIMED LANDS. (Utilization for plowland, plowing of steppes, melioration in non-black earth belt of northern regions, drainage of swamps, and irrigation of Zavolzhie (Volga region).

BASIS. Decision of the Academy. The necessity of providing a prognosis concerning change in interrelationship between the basic elements of biocoenosis and the establishment of causes for mass flare-ups of insect invasions in cases where

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soils are claimed for agricultural use, as well as in connection with changes in climatic factors for the subsequent development of a system of measures.

ANTICIPATED RESULT IN 1935. Segregation of a group of species capable of proving dangerous on claimed lands for use under agricultural crops, as well as an analysis of conditions under which similar outbursts may take place.

Section 1. Study of composition and dynamics of biocoenosis in the black earth belt, in connection with utilization of virgin soils and pastures.

Method of Work: Complex research of different types of successive series by means of mass-statistical recordings of insect fauna, biological surveys and ecological tests. Stationary and trans-zonal observation.

Experimentor: Bei-Bienko, specialist in science.

Period: January to December, 1935

Section 2. Determination of principal qualitative and quantitative changes in the fauna of insects, rodents, and the micro-flora in the podzol zone, in connection with the utilization of new soils and the melioration of swampy areas.

Method of Work: Recording of fauna in two types of successive series: 1. forest, uprooted field, sowing; 2. swampy plot, drained plot, sowing, by parallel biological surveying and the taking of tests. Stationary and trans-zonal surveying. ("izsledovania")

Experimentor: Moscow STAZRA

Period: January to December, 1935

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Responsible brigade leader on the subject: Bei-Bienko, G. Ia., specialist in science; participants: VIZRa and Moscow STAZRA.

Period: To begin in 1935. Subject perennial.
Method of research to be developed in 1935 and analysis made of composition of biocoenosis.

5. STUDY OF PARASITIC FUNGI AND BACTERIA OF HARMFUL INSECTS AND THEIR UTILIZATION IN PEST CONTROL.

BASIS: Decree of SNK USSR. (Council of Peoples' Commissars). Necessity of study of influence of parasite fungi and bacteria upon harmful insects and their utilization in the control of agricultural pests.

ANTICIPATED RESULT IN 1935. Introduction of new methods in insect control. Determination of possibility of using pathogenic fungi in the control of citrus scale (Coccidae) and San Jose scale under USSR conditions, as well as the use of sporidiferous bacteria in controlling the corn borer and leguminous pests.

Section 1. Study of fungi found on harmful insects (scale of lemon trees, locust, Loxostege sticticalis L. ("lugovoi motylek") and tests on the infection of scales and other insects with fungus cultures.

Method of Work: Work is conducted at laboratory and nursery. Micro-biological observation of diseased insects, the obtaining of cultures of fungi, and the establishment of infection experiments with culture derived from harmful insects.

Experimentor: Prof. V. P. Pospelov.

Period: February to December, 1935.

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Section 2. Study of bacterial diseases of insects and use of sporidiferous bacteria in the control of harmful insects (caterpillars of pests of leguminous and orchard plants.)

Method of Work: Laboratory and field work; application of bacteriological method and field tests which include infection of caterpillars of butterflies with cultures of bacteria.

Experimentors: Khedaturova, P. A. and Zaitseva, A.

Period: March to December, 1935.

Responsible brigade leader on the subject: Prof. V. P. Pospelov. Participating in the work will be one worker from the observation point of SUR.

Period: To start in 1934, to end in 1937. Subject transitory.

6. DETERMINATION OF RACIAL COMPOSITION OF RUST, SMUT, FUSARIUM OF CEREAL CROPS: DETERMINATION OF THE NATURE OF PLANT RESISTANCE AND METHODS DESIGNED TO INCREASE AND EVALUATE IT.

BASIS: Decision of the Academy. Conducted for the purpose of utilizing immunity in the control of fungi diseases most dynamic in propagation.

ANTICIPATED RESULT: Development of diagnostic traits (characteristics of resistance and establishment of methods for increasing resistance to the following diseases: rust, smut, fusarium and phytophthora. Development of methods for recognizing rust and smut and their virulence (in Soviet Union). Accumulation of data on racial composition of rust, smut, and conditions of their racial formation in the Soviet Union.

Section 1. Development and evaluation of methods for recognizing the racial

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composition of rust (Puccinia tricticina) and smut (Tilletia tritici).

Method of Work: Relative evaluation of different methods (physiological, biochemical, serological, citological, morphological) in work with 15 races of rust and smut.

Experimentors: Rashevskaia, V. F., sr. specialist in science; Barmenkov, A. S., sr. specialist in science; Gutner, L. S. of the Crimean Government University (specialist Strelin, S. L.).

Period: January to December, 1935

Section 2. Development of diagnostic method in recognizing multi-poisonous and specialized species of fusarium.

Method of Work: Physiological and biochemical study of 20 species and 10 races of fusarium.

Experimentors: Veselova, A. N., specialist in science.

Period: January to December, 1935.

Section 3. Development of methods for recognizing viruses and determining their specializations.

Method of Work: Development of serological method in recognizing specialization, activities and pathogenesis of viruses. Work conducted on 6 viruses of potatoes and tobacco.

Experimentors: Matsulevich, B. P., sr. specialist in science and Institute of Moist Sub-tropics (specialist Lobik, A. I.).

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Period: January - December, 1935.

Section 4. Biochemical determination of nature of immunity in wheat to rust.

Method of Work: Analysis on phenol and tannin combinations at different stages of development of 50 varieties and species of wheats.

Experimentor: Kargopolova, N. N., sr. specialist in science.

Period: January to December, 1935.

Section 5. Determination of varietal resistance of plants according to immuno-biological properties of fibre.

Method of Work: serological analysis of resistant and susceptible 95 varieties of wheats, oats and leguminous to smut (for cereals to fusarium and viruses).

Experimentors: Fedotova, T. I., sr. specialist in science, specialist Vedeneeva (Central-Asiatic STAZRA) and specialist Ulianishchev (AzSTAZRA). (Azerbaidjan STAZRA)

Period: January to December, 1935.

Section 6. Method and technique of serological research on immunity of plants.

Method of Work: Relative evaluation of adaptability, suitability of serological methods (known in medicine) for vegetative immunology, their improvement and detailedness.

Experimentor: Tumarinson, scientific worker.

Period: January - December, 1935.

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Section 7. Determination of racial composition of rust in zonal cross-section of USSR.

Method of Work: Tests on artificial infection of varieties by local rust populations. Establishment of races according to intensity and the nature of injury caused to varieties (American standard varieties) and the varieties from the varietal network of the Soviet Union. Collecting of material and its treatment.

Experimentors: Rashevskaia, V. F., sr. specialist in science; Darmenkov, A. S., sr. specialist in science; SUR(Sector of Statistical Recording and Regionalization of All-Union Institute of Plant Protection), Proida, P. A.; VIR, Spangenberg.

Period: January, 1935 to April, 1936.

Section 8. Determination of racial composition of smut in zonal cross-section of USSR.

Method of Work: Collecting of specimens (samples) and their treatment by laboratory method.

Experimentors: Rashevskaia and Laboratory of Systematization, Gutner, L. S., scientific worker; SUR, Proida, P. A.

Period: January, 1935 to April, 1936.

Responsible brigade leader on the subject: Fedotova, T. I., scientific specialist.

Participators: VIZRa, network of STAZRA, Institute of Moist Sub-Tropics, SUR and VIR.

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Period: Early 1935. Subject perennial.

7. CRITICAL EVALUATION AND IMPROVEMENT OF METHODS OF STATISTICAL RECORDING OF LOSSES FROM AGRICULTURAL PESTS AND DISEASES.

BASIS: Decree of Narkomzem of the Soviet Union. Necessity for developing methods of recording losses from pests and diseases.

ANTICIPATED RESULT IN 1935. Systematic guidance on methods and technique of statistical recording of losses.

Section 1. Development of methods to determine losses.

Method of Work: Scientific processing of data. Introduction of biological surveying by producing maps on the distribution of pests and yields.

Experimentor: Professor A. A. Lubishchev.

Period: January to December, 1935.

Section 2. Determination of losses from rusts of cereal crops.

Method of Work: Mathematical treatment and literary presentation of collected data. Field method in dusting and applying artificial infection combined with the individual method; typographical surveying and statistical recording of degrees of infection according to season.

Experimentors: Sr. Specialists in science Shitikova and Ageeva.

Period: January to December, 1935.

Section 3. Development of method of statistical recording of damage caused by losses from fungus diseases of flax.

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Method of Work: Mathematical-statistical treatment and literary presentation of accumulated data. Preparation of maps on the distribution of rust. Approximate statistical record of losses on flax-"dolgunets" (flax rust(?) melampsora lini (Pers.) in USSR cross-section. Biological survey. Introduction of morphological and technical analysis down to the fibre.

Experimentor: Scientific worker Nestereva. Participating: Institute of Flax.

Period: January to November, 1935.

Responsible brigade leader on the subject: Professor A. A. Lubishchev; participant worker of VIZRa, network of S.U., Institute of Flax.

Period: Subject transitory, to end in 1935.

Section 4. Physiological characteristic of wilt of cotton to determine the mechanism of this factor (typical wilt).

Method of Work: Vegetative test with artificial infection and subsequent physiological analysis.

Experimentor: Kokin.

Period: January - December, 1935.

Section 5. Physiological study of wilt of cotton ("tracheomicoses"(?).

Method of Work: Vegetative test including artificial infection and subsequent analysis.

Experimentor: Scientific worker Saburova.

Period: March to December, 1935.

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Section 6. Anatomical study of wilt of cotton (typical wilt).

Methods of Work: Vegetative and laboratory tests including artificial infection and subsequent microscopic analysis.

Experimentor: Scientific worker Iablokova.

Period: March to December, 1935.

Section 7. Physiological basis for the damaging effect of rust of highly resistant wheat varieties.

Method of Work: Vegetative method to include artificial infection and subsequent physiological analysis.

Experimentor: Scientific worker Mel'nichenko-D'iakonova.

Period: February to December, 1935.

Section 8. Physiological study of tobacco damaged by mosaic at different stages of development.

Method of Work: Vegetative, artificial infection and subsequent physiological analysis.

Experimentors: Donnikova and Kokin.

Period: January to December, 1935.

8. CRITICAL EVALUATION AND IMPROVEMENT OF METHODS OF STATISTICAL RECORDING OF EFFICACY OF MEASURES IN THE CONTROL OF AGRICULTURAL PESTS AND DISEASES.

BASIS: Necessity for developing methods for recording the efficacy of measures and the presentation of approximate norms, in conformance with the decree of the

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Sovnarkom of the USSR.

ANTICIPATED RESULT IN 1935. Systematic guidance on statistical recording on efficacy of measures designed to control pests and diseases.

Section 1. Development of methods to determine efficacy of applied measures.

Method of Work: Scientific processing of accumulated material; experimental work at observation points of SUR and statistical treatment of produced data.

Experimentors: Pervukhin, Central-Asiatic STAZRA, Namagan observation point; Azerbaidjan STAZRA, Voronezh STAZRA, statistician Chernova.

Period: January to December, 1935.

Section 2. Technical-economic determination of types of fungicidal dipping machinery ("protravochnye") and the establishment of complexes of machinery for grain MTS.

Method of Work: Establishment of precise statistical recording during the operation of machines and their tractive power by photographing the working day; and recording the individual processes and operations of work. The latter covers the entire time the machine is in operation through the organization of links at permanent brigades at collective farms; technical efficacy is recorded in subsequent mathematical analysis of accumulated figures.

Experimentors: sr. specialists in science Kosikhin and Ogarkov.

Period: January, 1935 to January, 1936.

Responsible brigade leader on the subject: dotsent Pervukhin, F. S. (VIZRa).

Participating: Central-Asiatic STAZRA, LenSTAZRA, observation points of SUR.

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Period: Subject transitory, to end in 1935.

9. CRITICAL EVALUATION AND IMPROVEMENT OF METHOD OF SURVEYING AND STATISTICAL RECORDING OF DISTRIBUTION AND NUMBER OF HARMFUL INSECTS AND DISEASES.

BASIS: Necessity for correcting existing instructions, in conformance with VASKHIL decision. Lack of handbooks on statistical recording of pests and diseases of underground legumes, soil pests, and correction of existing instructions.

ANTICIPATED RESULT. Compilation of instructions on (statistical) recording of pests and diseases of leguminous underground crops, soil pests, revision of existing instructions.

Section 1. Revision of methods of work of observation points of S.U. To be performed in the active areas of Slaviansk, Primorsko-Akhtarsk and Anapa observation points, with regard to the corn borer, grain beetles, smut, rust, leaf beetle, gummosis, red spider Tetranychus urticae Koch and Homoptera ("tlia") on cotton, apple and pear scab, leaf roller moth ("plodozhorka") Graptalitha, mildew and oidium of grape.

Method of Work: Stationary statistical recording and surveys in active regions at observation points. Trans-zonal routes for surveys.

Experimentors: Sector of Statistical Recording Service of VIZRa, Slaviansk Primorski-Akhtarsk and Anapa observation points.

Period: April to December, 1935 and first quarter of 1936.

Section 2. Establishment and improvement of existing method for testing samples in quantitative recordings of: soil pests, spider tick, Tetranychus urticae Koch, rust of wheat, (ergot) spurred rye (Claviceps purpurea), gummosis

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of cotton, phytophthora of potatoes, apple scab, mildew of grape.

Method of Work: Bio-survey with subsequent varietal-statistical treatment of data, in order to determine size, number and distribution of samples on the plot, depending upon the latter's size, area, ecological conditions, and the nature of distribution of pests and diseases.

Experimentors: Armavir, Sinel'nikov, Minsk, Galich, Ural-observation points, to be supervised by Iaroslavtsev, Korovkina, the Sector of Spinning Crops of VIZRa, under the leadership of Galakhov through the network of observation points.

Period: April to December, 1935 and first quarter of 1936.

Section 3. Development and improvement of method of prognosis on rodents, locusts (Acridodea), grasshopper, ("prus") and Aroyptera microptera F. W. ("krestovaia kobylka"); pests of Cruciferae; flax fleas (?) Ph. cruciferae Goeze (?); loose smut of wheat; ergot.

Method of Work: Field studies and compilation of systematic handbook based on obtained data. Stationary statistical recording of quantities with an analysis of meteorological conditions. Statistical recording of production.

Experimentors: Zoological Institute 1 of MGU (Moscow Government University), Kuibishev, Lenin observation points under the supervision of Predtechenskii; Meritopol, Keles, Petrovskii observation points to be supervised by Proida; Kiev, Cherepovets observation points supervised by Markhaseva; Gorki, Gubarev, Tambov observation points by Iakhimovich; Smolensk and Bezhenskii observation points guided by Semenov.

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Period: February to December 1935.

Section 4. Revision and utilization of existing method of statistical recording of pests and diseases.

Methods of Work: Accomplished under conditions prevailing in barns, elevators and mills in relation to storage pests.

Experimentors: Saratov, Simferopol, Armavir observation points supervised by Asiatic-Black Sea STAZRA (Smoliannikova).

Period: March to December, 1935.

Section 5. Development of methods of statistical recording of quantities of rodents in storage warehouses, barns and nurseries.

Method of Work: Statistical recording of numbers in places of mass accumulation and observation of migration.

Experimentors: Three observation points under the guidance of Zolotov.

Period: April to December, 1935.

Section 6. Development of method for recording pests and diseases of vegetable underground crops.

Method of Work: Determination and economic significance of the composition of harmful entomic-fauna and micoflora; the establishment of periods, and methods of recording number and size of sample specimens.

Experimentors: Leningrad observation point, supervised by Chesnokova, Moscow observation point under the guidance of Moscow STAZRA.

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Period: May to December, 1935.

Section 7. Development of method to record pests and diseases of sub-tropical crops.

Method of Work: Evaluation of existing methods applicable to sub-tropics.

Experimentors: Sukhum and Batum observation points under the supervision of AzSTAZRA (Shonanashvili). (Azerbaidjan STAZRA.)

Period: April to December, 1935 and first quarter of 1936.

Responsible brigade leader Volkov, V. F.; branch sectors of VIZRa; network of observation points and Slaviansk Scientific-Industrial Base.

Period: From early 1935 to end in 1936.

Section 8. Development of systematization of some harmful phycomycetes, powdery scab ("poroshistaia parsha"), resembling the inducers of potato canker and others.

Method of Work: Laboratory-scientific processing.

Experimentor: Professor N. A. Naumov.

Period: April to December, 1935.

10. DETERMINATION OF CAUSES OF DISEASES, EPIDIMIOLOGY AND FUNGI DISEASES OF BACTERIUM OF AGRICULTURAL PLANTS.

BASIS: Necessity for developing methods of controlling bacterial diseases of agricultural plants.

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ANTICIPATED RESULTS IN 1935. Determination of bacterium in cultures and recording of areas of their distribution in the USSR.

Section 1. Distribution and economic significance of bacterium of agricultural crops in the USSR.

Method of Work: Stationary and field observation and scientific processing of collected material. Preparation of maps of distribution and harmfulness of the most important bacterium of technical, grain and leguminous crops of the USSR.

Experimentor: Vacancy

Period: April, 1935 to February, 1936.

Section 2. Study of possibility for utilizing bacteria-antagonists in the control of fusarium of cereal crops.

Method of Work: Laboratory research of pure and mixed cultures. Vegetative and field experiments against a background of natural-historical and artificially infected bacteria-soil and seeds and different species of fusarium.

Experimentor: Vacancy

Period: April, 1935 to November, 1936.

Section 3. Mastering of world experience in studying bacterium of plants.

Method of Work: Scientific processing, literary presentation.

Experimentor: Vacancy

Period: April, 1935 to March, 1936.

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Responsible experimentor on the subject: Dunin, S. M.

Period: From early 1935 to end in 1937.

11. STUDY OF NATURE OF FILTERABLE VIRUS AND DEVELOPMENT OF MEASURES OF CONTROLLING VIRUS DISEASES.

BASIS: Necessity for developing diagnosis of diseases and determination of nutritional specialization of viruses, as well as determination of methods for controlling virus diseases in connection with their propagation in masses.

ANTICIPATED RESULT. Development of methods for controlling virus diseases. Inventory of viruses of southern agricultural plants (tobacco, sugar beet, tomatoes) and their diagnosis.

Section 1. Determination of composition of species, the geographical distribution and economic significance of virus diseases of plants in the USSR.

Method of Work: Stationary and field research and scientific processing of material. Preparation of maps on the distribution of virus diseases of principal crops (sugar beet, potatoes, tobacco, cotton, grain-leguminous, tomatoes, grapes) and regional characteristic of harmfulness of virus diseases.

Experimentor: Kozlova, V. I.

Period: April, 1935 to March, 1936.

Section 2. Development of methods of virose examination of seed stock material.

Method of Work: Experimental. Application of immuno-biological reactions; determination of pathological symptoms in early stage of development of seedlings.

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Experimentor: Vacancy

Period: To begin in 1935, to end in 1937.

Section 3. Development of method of cultivating viruses in fungi and bacteria.

Method of Work: Field method and testing of viruses in pure culture of fungi and bacteria under laboratory conditions.

Experimentor: Dunin, S. M.

Period: To begin in 1935, to end December, 1936.

Section 4. Study of role of insects in the spread of viruses.

Method of Work: Field experiments and laboratory histological and citological research of collected material (virus plants and insects).

Experimentor: Vacancy

Period: To begin in 1935, to end February, 1937.

Section 5. Mastering of world experience and composition of critical summary on virus diseases. General and individual virosis of plants.

Method of Work: Scientific processing, laboratory treatment of material.

Experimentor: Vacancy.

Period: To begin in 1935, to end December, 1936.

Responsible experimentor on the subject: Scientific specialist Dunin, S. M.

Period: To begin in 1935, to end in 1937.

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12. STUDY OF ELECTRO-PHYSICAL METHOD OF CONTROLLING PESTS AND DISEASES OF STORED GRAIN AND SUPPLIES.

BASIS: Necessity for utilizing contemporary achievements in electrical physics in the control of pests and diseases of grain and stored supplies.

ANTICIPATED RESULT IN 1935. Development of methods of primary solution, as well as the practical application of UKV (ultra-short waves), X-ray and currents of high frequency in controlling ticks of grain and other grain and flour pests, inducers of diseases of flax, smut and fusarium of wheat.

Section 1. Study of biological reaction of area of high frequency upon pests of grain and flour (objects are taken from among those that are studied easiest).

Method of Work: Study of literature. Determination of physical condition of objects yielding to the reaction of electro-physical methods of control. Study of area of high frequency from the standpoint of its biological influence upon the object under study.

Experimentor: sr. scientific specialist Kuznetsova.

Period: January to December, 1935.

Section 2. Study of biological reaction of area of high frequency upon inducers of grain diseases.

Method of Work: Study of literature. Determination of physical condition of objects succumbing to the reaction of electro-physical methods. Study of area of high frequency from the standpoint of its biological reaction.

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Experimentors: Scientific worker Kutuzova, phytopathologist, and electrophysicist Khormushko.

Period: January to December, 1934.

Acting responsible brigade leader on the subject: Kuznetsova.

Period: To begin in 1935; subject transitory.

13. ECOLOGICAL-ECONOMIC BASIS OF MEASURES FOR PROTECTION AGAINST PESTS AND DISEASES OF AGRICULTURAL GRAIN CROPS AND DEVELOPMENT OF CONCRETE MEASURES APPLICABLE TO ONE OF THE GRAIN REGIONS OF THE CENTRAL BLACK EARTH BELT.

BASIS: Decrees of SNK of USSR and the Lenin Academy. Necessity for changing from a system of measures involving individual pests and diseases to a system concerning the culture in general.

ANTICIPATED RESULT IN 1935. Compilation of all literary and recording data, primary regionalization, setting up of a system of measures, the compilation of a handbook for the preparation of an industrial plan designed to control pests and diseases.

Section 1. Ecological-economic regionalization and preparation of maps of general areas, segregation of harmful zones and the analysis of causes determining this zoning.

Method of Work. Statistical and graphic analysis.

Experimentors: [illegible]-Hessen and Swedish flies; Karpova; Znamenskii, Lubishchev, Kreuter;

Loxostege sticticalis: Znamenskii;

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loose smut: Proida, Bubentsov;

rust: Markhaseva, Kotova;

grasshopper ("prus") for Kazakhstan: Chetyrkina;

cicada marrocean: Bei-Bienko, Zhdanov;

In addition, the grain industry utilizes data on the regionalization of ground squirrel, "susliks" (Citellus), experimentor Falkenstein; ergot, Markhaseva; winter cutworm moths ("ozimaia sovka") Agrotis segetum Schiff., Nikitin; asiatic locust, Predtechenskii; wireworms, Iaroslavtsev and Grigorieva.

Period: March to December, 1935 (See subject).

Section 2. Summary of entire data on pests and diseases of grain crops (cereal and leguminous) of the Central black earth belt.

Method of Work: Summarizing and compilation of brief conclusions from all literary, recording and report data relating to the list of pests and diseases found in the Central black earth belt (Kursk and Voronezh oblasts), including a plan of primary regionalization based on the natural and agricultural regionalization of the above oblasts.

Experimentors: Grain crops: Karpova, A. I., Kreuter, E. A., Znamenskii, A. V.
Diseases of cereal crops: Proida, Naumov, Maklakova; Tupenevich, Kotova.
Pests of legumes, cereal and oil crops: Vassiliev, I. V. Karpova, A. N.
Rodents: Obolenskii.
Locusts: Bei-Bienko, Zhdanov.
Winter cutworm moths, Agrotis segetum Schiff.: Nikitin;
Wireworms: Iaroslavtsev;
Loxostege sticticalis: Kreuter, Znamenskii.

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The compilation of the review of pests and diseases and the micro-regionalization of the Central black earth belt is conducted at Voronezh STAZRA (Boevskii, A. S.) with utilization of all local material.

Period: January to December, 1935.

Section 3. Experimental test of individual methods for controlling pests and diseases (agro-technical and special).

a) Vernalization and periods of sowings of summer crops.

Method of Work: Test is made in a geographical cross-section and takes into consideration the damage caused by pests and diseases to vernalized and non-vernalized sowings in agro-technical tests (?) upon agreement with experimental stations) and on industrial sowing areas (through observation points of U. S.)

Experimentors: Voronezh STAZRA (Boevskii, A. S.), Shatilov Experiment Station, Tambov Experiment Station, Western Experiment Station, Azovo-Black Sea Territorial Experiment Station, points of the GOSSORTSET' (Government varietal network), Odessa Genetic Institute, all observation points dealing with grains; Grain Institutes: Ukrainian, Saratov, and Northern Grain Institute with their respective networks of zonal and collective farm experiment stations; cottage laboratories of the collective farm "New Path."

Systematic supervision by Znamenskii, A. V. and Kreuter, E. A.

Period: April to December, 1935.

b) Evaluation of standard varieties of summer wheat with respect to susceptibility to injury by fusarium.

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Method of Work: Geographical experience. Statistical recording on sowing areas of Gossortset' and VIR.

Experimentors: Tupenevich; participating are the network of experiment stations, and Voronezh STAZRA (Boevskii, A. S.)

Period: April to December, 1935.

c) Testing of new fungicides (sulfide hydrogen, etc.) for disinfection of grain from fusarium.

Method of Work: Laboratory experiments; with growth conducted in vegetative vessels.

Experimentor: Kholodniuk

Period: January to December, 1935.

d) Summary of tests on new fungicides against smut, conducted in the preceding years.

Method of Work: Literary summary

Experimentor: Voronezh STAZRA (Boevskii, A. S.)

Period: November, 1935.

e) Test of thermic mordant treatment.

Method of Work: Industrial test on farms

Experimentor: Charopovets observation point (Euprianova)

Period: January to November, 1935.

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f) physiological evaluation of viability of inducer of loose smut in infected wheat grain.

Method of Work: Laboratory study of physiology of growth of mycelium of smut.

Experimentor: Skvortsov

Period: January to December, 1935

g) Evaluation of efficacy of destruction of intermediary hosts of rust

Method of Work: Conducted against a background of general bio-survey with statistical recording of periods and dosages of fungicides.

Experimentor: Voronezh STAZRA (Gorlenko)

Period: January to December, 1935

h) Fallow cultivation (treatment); periods and methods, in connection with the propagation of winter cutworm moth ("ozimaia sovka") [Agrotis Segetum, Schiff.]

Method of Work: Statistical recording of density of caterpillars and damage suffered on different fallows.

Experimentors: Voronezh STAZRA (Ostapets, A. P.) and network of observation points.

Period: January to November, 1935.

Section 4 a). Study of regularities of distribution of winter cutworm moth by locality, connected with economic and climatic conditions.

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Method of Work: Evaluation of influence of microclimatic conditions depending upon the vegetative layer of the soil and its cultivation; statistical recording of the degree of infection according to localities; study of conduct of butterflies and conditions of egg laying with statistical recording of micro-climatic factors.

Experimentor: Kirt, L. I.

Period: June to October, 1935.

b) Role of shelter forest belts in the propagation and preservation of pests and diseases of field crops.

Method of Work: Compilation of list of pests and diseases; surveying of forest shelter belts.

Experimentor: VIZRa (Karpova)

Period: May to October, 1935

c) Significance of leguminous wedge (?) "klin" and varieties in the post-harvest period in the causing of the preservation of [Loxostege sticticalis] and other pests.

Method of Work: Study of conditions contributing to the revivification of extinct foouses of [Loxostege sticticalis.] Trans-zonal surveying; statistical recording of pests on stubble residue and weeds.

Experimentor: VIZRa (Melnichenko, A. N.) and network of observation points

Period: May to December, 1935

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d) Study of bio-ecology and economic significance of pests of peas ("listovertka"), [Polychrosis botrana Schiff.], aphid and [Curculionidae].

Method of Work: Study of biology under natural conditions and recording of degree of injury.

Experimentor: Voronezh STAZRA (Selivanova)

Period: April to November, 1935

e) Determination and primary study of distribution and economic significance of bacterial diseases of agricultural plants.

Method of Work: Collection of specimens; segregation of inducers.

Experimentors: Voronezh STAZRA, Tambov Experiment Station, Institute of Grain-leguminous (Dunin, S. N.)

Period: May to December, 1935

f) Development of methods of phyto-appraisal of seeds of peas and beans on fusarium.

Method of Work: Laboratory research with testing; vegetative experiments

Experimentor: Voronezh STAZRA (Boevskii, A. S.)

Period: January to December, 1935

g) Study of conditions of destruction of winter crops from rotting (sweating).

Method of Work: Vegetative experiments.

Experimentor: Tupenevich

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Period: May to December, 1935

h) Bio-ecology of infection of oats with smut

Method of Work: Observation of development of infection and statistical recording of meteorological factors.

Experimentor: Cherepovets observation point (Kuprianova)

Period: May to December, 1935

Section 5. Complex testing of measures designed to control pests and diseases.

Method of Work: Development of diagram of records and segregation of experimental sowings.

Experimentor: Voronezh STAZRA (Boevskii, A. S.), cottage-laboratory at Talov MTS and collective farm imeni Kalinina.

Period: March, 1935 to February, 1936.

a) Evaluation of anti-smut system of measures.

Method of Work: Development of diagram for recording efficacy.

Experimentors: Voronezh STAZRA (Boevskii), cottage laboratory at Talov MTS and collective farm imeni Kalinina.

Period: March, 1935 to February, 1936.

b) Evaluation of types of machinery. Testing of fungicidal dipping machinery.

Method of Work: Field experimentation

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Experimentors: Sector of Mechanization of VIZRa (Davidov)

Period: March to December, 1935

c) Establishment of sources of regeneration of rust in conducting destruction intermediary hosts.

Method of Work: Bio-survey

Experimentors: Voronezh STAZRA (Gorlenko) with the participation of VIZRa (Maklakova), the cottage laboratory at collective farm "Komsomolets" and cottage laboratory at collective farm "New Path."

Period: March to December, 1935

Section 6. Segregation of sub-farms and their preparation for conducting experiments to test systems of measures.

Method of Work: Bio-survey of the entire territory of the farm; recording the quality and efficacy of measures conducted in it; preparation of diagram of conducted tests.

Experimentors: Voronezh STAZRA (Boevskii, Gorlenko, Zazhurilo, Pavlov); VIZRa (Luibishchev, Pervukhin, Kosikhin).

Period: March to December, 1935

Section 7. Compilation of a system of measures, its review and confirmation by the Grain Administration of NKZ (Narkomzem) at oblast and regional conferences.

Method of Work: Organizational

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Experimentors: VIZRa, Voronezh STAZRA, Talov MTS, Grain Administration of NKZ of USSR, Voronezh ObLZU (Oblast Land Administration), Talov RaiZU (Regional Land Administration)

Period: January to July, 1936.

Section 8. Method of laboratory analysis and methods of evaluation of the significance of various degrees of infection of seeds of barley by helminthosporiose.

Method of Work: Laboratory-field

Experimentor: Scientific worker Safronova.

Period: April 15, 1935 to April 1, 1936.

Section 9. Development of methods for evaluating norms of permissable degree of infection of seeds of wheat by fusarium.

Method of Work: Laboratory-field

Experimentor: Scientific worker Safronova.

Period: March 1, to December, 1935.

Section 10. Development of methods for appraising seeds of wheat with regard to loose smut.

Method of Work: Laboratory experimental work.

Experimentor: Sr. Scientific worker Budrina.

Period: March to December, 1935.

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14. ECOLOGIC-ECONOMIC BASIS AND DEVELOPMENT OF SYSTEM OF MEASURES OF PROTECTION FROM PESTS AND DISEASES OF COTTON IN THE OLD COTTON REGIONS OF UZBEKISTAN AND AZERBAIDJAN.

BASIS: The necessity for synthesizing the accumulated material and the importance of developing measures for plant protection in the cotton industry.

ANTICIPATED RESULT IN 1935. Plan of measures for controlling pests and diseases of cotton in old cotton regions.

Section 1. Development of measures against red spider ("pautinny kleshchik") [Tetranychus urticae Koch.].

Method of Work: Laboratory, field; subsequent scientific processing.

Experimentor: VIZRa (Nikolskii); participating are: SAUZRa, Central Asiatic NIKHI, Zak. NIKHI and the network of SUR.

Period: January to December, 1935.

Section 2. Development of measures dealing with aphids on cotton.

Method of Work: Laboratory-field and scientific processing

Experimentors: VIZRa (Nikolski); participating: SAIZRA, Central-Asiatic NIKHI, Zak. NIKHI and network of SUR.

Period: March to December, 1935

Section 3. Collecting material for building up a system of measures directed against rodent pests.

Method of Work: Laboratory-field; subsequent scientific processing.

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Experimentor: VIZRa (Nikolskii), participants: SAIZRA, Central-Asiatic NIKHI, Zak.NIKHI and network of SUR.

Period: March to December, 1935.

Section 4. Development of system of measures for controlling pests of alfalfa in cotton regions of Central Asia and Azerbaidjan.

Method of Work: Field; subsequent scientific processing.

Experimentor: VIZRa (Nikolskii); participants: SAIZRA, Central-Asiatic NIKHI, Zak.NIKHI and network of SUR.

Period: January to December, 1935.

Section 5. Development of system of measures directed against cotton (cutworm moth?) on cotton plants [Agrotis Segetum Schiff].

Method of Work: Laboratory-field; subsequent scientific processing.

Experimentor: VIZRa (Galakhov); participants: SAIZRa, Central-Asiatic NIKHI, Zak.NIKHI and network of SUR.

Period: January to December, 1935.

Section 6. Development of measures against [Laphygma exigua Hb.] ("Karadrina") on cotton plant.

Method of Work: Laboratory-field; subsequent scientific processing.

Experimentor: VIZRa (Galakhov); participants: SAIZRA, Central-asiatic NIKHI, Zak.NIKHI and network of SUR.

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Period: January to December, 1935

Section 7. Preparation of plan of measures for the liquidation of studied focuses of locusts harmful to cotton.

Method of Work: Field; subsequent scientific processing

Experimentor: VIZRa (Predtechenskii)

Period: January to December, 1935

Section 8. Development of system of measures against veticilliose of cotton wilt.

Method of Work: Mastering of world literature. Laboratory and field research.

Experimentors: VIZRa (Letov); participants Zak.NIKHI and network of SUR. Laboratory of pathological-physiological VIZRa.

Section 9. Development and improvement of system of measures against gummosis of cotton plant.

Method of Work: Checking of system of measures in industry. Development of control methods and additional processing of individual methods.

Experimentor: VIZRa (Letov), with the participation of the Sector of Mechanization of VIZRa (Meisakhovich), SAIZRAa, Central-Asiatic NIKA, Zak.NIKHI, Nov. NIKHI, Azovo-Black Sea STAZRA and network of SUR.

Period: January to December, 1935.

Section 10. Collecting of material for setting up measures for the control of virus and other diseases of cotton.

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Method of Work: Field and laboratory observations and experiments.

Experimentors: Zak.NIKHI and Nov. NIKHI.

Period: January, 1935 and January, 1936.

Section 11. Techno-economic foundation for types of machinery used in the control of pests and diseases of cotton in cotton regions of Central Asia and Trans-Caucasus.

Method of Work: Field

Experimentor: VIZRa (Pushin) together with Central-Asiatic NIKHI and Zak. NIKHI.

Period: January to December, 1935.

Section 12. Review of existing systems of measures applied to pests and diseases of cotton in old cotton regions.

Method of Work: Field.

Experimentors: VIZRa, SAIZRAa(Redis) and Central-Asiatic NIKHI, network of observation points of SURa.

Period: January to December, 1935.

Section 13. Compilation of plan of complex system of measures for the control of pests and diseases of cotton and alfalfa.

Method of Work: Scientific processing.

Experimentors: VIZRa (Nikolskii, Predtechenskii, Galakhov, Letov), SAIZRAa, Central-Asiatic NIKHI, Zak.NIKHI and Nov. NIKHI.

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Period: January, 1936.

15. ECOLOGO-ECONOMIC BASIS OF SYSTEM OF MEASURES FOR PROTECTION AGAINST PESTS AND DISEASES OF HEMP UNDER CONDITIONS OF THE FOREST STEPPE ZONE.

BASIS: Necessity for determining the efficacy of measures and the ecological-economic basis of the latter in order to build up a system of measures in the hemp growing industry.

ANTICIPATED RESULT IN 1935. Summary of work for 1935 will include plan of a complex system of measures and its theoretical basis.

Section 1. Statistical recording and dynamics of pests of hemp.

Method of Work: Summary of data of SUR for the years 1930 - 34. Organization of records for 1935 and yearly summary accompanied by prognosis.

Experimentors: Ladyzhenskaia and Dr. Shchegolev. Participating: observation points of SUR and VNIKO.

Period: February to December, 1935

Section 2. Experimental study of methods for controlling the most important pests of hemp.

Method of Work: VIZRa acts as supervisor of work on the trichogramma (bio-method) and chemical measures in controlling the hemp flea (?) [Psylliodes attenuata Koch.] ("konoplianaia blokha").

Experimentors: Gorki STAZRA BNIKO.

Period: March to December, 1935

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Section 3. Ecological study of pests and diseases of hemp to establish system of measures.

Method of Work: Development of thermohygrogramma on corn borer, [Pyrausta nubilalis Hb.] ("kukuruznyi motylek" ili/(or)/steblovoi") under laboratory conditions and study of influence of microclimate upon its survival. Research by field method.

Experimentors: Ecological laboratory of VIZRa and Sector of Northern Spinning Crops. (Ladyzhenskaia).

Period: January to December, 1935.

Section 4. Study of region and industry for subsequent recording of efficacy of system of measures.

Method of Work: Study and bio-surveying. Selection of material characteristic of work. Organization and subsequent shaping into literary form.

Experimentor: VNIKO

Period: August to November, 1935, and January to July, 1936

Section 5. Development of system of measures for the control of pest and disease of hemp.

Method of Work: Critical analysis of obtained material and compilation of project. Discussion and confirmation of the latter at conference, to be held March, 1936.

Experimentor: Dr. V. N. Shchegolev with participation of VNIKO

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Period: October - December, 1935; February - March, 1936.

Responsible on the subject: Dr. V. N. Shchegolev.

Period: To begin in 1935, to end in second quarter of 1936.

16. ECOLOGO-ECONOMIC BASIS AND DEVELOPMENT OF SYSTEM OF MEASURES ON PROTECTION FROM PESTS AND DISEASES IN SHELTER BELTS OF SOUTH EASTERN EUROPEAN USSR.

BASIS: Decree of SNK of USSR on drought control. Decision of Academy, imeni Lenina, and necessity of studying conditions under which development of pests and diseases takes place during the creation and exploitation of shelter belts grown to protect agriculture from drought; subsequent development of measures in organizing pest and disease control to alleviate any damaging effect to shelter belt plantings.

ANTICIPATED RESULT IN 1935. On the basis of available data to compile list of woody genera suitable for forest shelter belts, immune from pests and diseases of forest shelter belts.

Section 1. Study of species of forest and shrub genera introduced in forest shelter belts to determine the composition of harmless agricultural pests from the standpoint of their residual habits.

Method of Work: Literary summary. Summary of material of SUR. Stationary field work and bio-survey. Statistical recording through observation points. Scientific processing of data. Approval of list of woody genera at special conference.

Experimentors: Sr. scientific worker Parfent'ev and network of observation

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points of SUR.

Period: February to December, 1935.

Section 2. Determination of role of forest shelter belts as places of location of propagation and formation of residues of pests and diseases of grain crops.

Method of Work: Summary based on literary data. Summary of materials of SUR. Field observations.

Experimentor: sr. scientific worker Parfent'ev, V. Ia. (Sector of Woody Crops) participating with Sector of Grain Crops (see subject 13)

Period: March to December, 1935

Section 3. Ecological-economic basis of measures in tree nurseries.

Method of Work: Field and stationary observations; collection of material through network of observation points; subsequent literary presentation.

Experimentor: aspirant V. L. Nikolskii

Period: March to December, 1935

Section 4. Study of composition of species of phenology of development, bioecology and quantity of pests and diseases in young and newly built field shelter belts.

Method of Work: Summary of literature and material of SUR. Observation through network of observation points. Field and stationary observation

Experimentors: sr. scientific specialist Kelus., O. G.; observation points

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of SUR (Kuibishev and Saratov Territories).

Period: April 15, 1935 to January 1, 1936.

Section 5. Phenological survey of pests and diseases of old forest belts and the segregation of economically harmful species of insects.

Brigade leader for the section: Dr. V. N. Stark.

a) Determination of processes of changes in the biocoenoses of soils during their transfer from steppe conditions into forests.

Method of Work: Literary summary and summary of material of SUR. Stationary field observation. Microclimatic survey.

Experimentors: sr. scientific specialist V. N. Berezina, laboratory worker L. N. Geyer. Participating: Ecological laboratory of VIZRa (aspirant Kosmachevskii, specialist in science, Prince, Ia. I.)

Period: February, 1935 to December, 1936.

b) Bio-survey of above-ground fauna of pests of forest belts.

Method of Work: Literary summary and summary of data of SUR. Stationary observations.

Experimentors: sr. specialist in Science Gusev, V. I., network of observation points (Kuibishev and Saratov territories).

Period: February to December, 1935.

c) Bio-survey of parasitic fungi of woody genera.

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Method of Work: Literary summary and summary of data of SUR. Stationary observations.

Experimentor: sr. specialist in science D. V. Sokolov.

Period: February to December, 1935.

d) Determination of economic significance of birds and establishment of tests for attracting birds into shelter forest belts.

Method of Work: Scientific processing, establishment of artificial nesting; stomach analysis.

Experimentor: sr. specialist in science Kistiakovskii, A. B.

Period: February to December, 1935.

e) Compilation of system of measures at old forest belts.

Method of Work: Scientific processing. Literary processing of material.

Experimentors: Dr. V. M. Stark, sr. specialists in science V. I. Gusev, V. M. Berezina, D. V. Sokolov, and A. B. Kistiakovskii.

Period: December, 1935.

Section 6. Compilation of summary on pests of fruit trees in south east of European USSR.

Method of Work: Literary summary and summary of material of SUR.

Experimentor: Sr. specialist in science Aristov, M. T.

Period: May to November, 1935.

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Section 7. Compilation of system of measures for forest shelter belts.

Method of Work: Scientific processing; literary presentation.

Experimentors: All staff members of Sector of Woody Crops of VIZRa.

Period: December, 1935.

Responsible brigade leader on the subject: Dr. V. N. Stark

Period: To begin in 1935, to end 1936.

(Omitted Sector 17) p. 22 and 23.

18. ECOLOGICAL-ECONOMIC BASIS AND DEVELOPMENT OF METHODS FOR UTILIZING PARASITES AND RODENTS IN CONTROL OF PESTS OF AGRICULTURAL CROPS.

BASIS: Necessity of finding means to utilize local rodents and parasites (trichogramma) and (chilocorus) so as to organize and introduce biological methods in/control and transfer of methods and techniques, to USSR territory; the acclimatization of foreign cryptolaemus and coccophagus and importation of rodents and parasites from Far Eastern Territory.

ANTICIPATED RESULT IN 1935. Determination of means of organizing the control of the corn borer, [Pyrausta nubilalis Hb.,] under production conditions and the determination of possibility for the transfer and acclimatization of rodents of the Far East.

Section 1. Utilization of trichogramma in corn borer control.

Method of Work: Specific method of mass propagation of rodents and pests. Determination of dormancy under laboratory conditions.

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Determination of efficacy of above rodents and parasites under conditions of wide industrial application.

Experimentor: VIZRa (Meyer and Afanasieva).

Period: January to December, 1935.

Section 2. Importation, acclimatization and methods of mass propagation of coccofphagus.

Method of Work: Laboratory propagation and release under field conditions.

Experimentor: VIZRa (Meyer and Telenga)

Period: January to December, 1935.

Section 3. Expedition to Far Eastern Territory for the purpose of locating rodents and parasites of harmful insects.

Method of Work: Observation.

Experimentor: VIZRa (Telenga and Bogunova)

Period: May 15 to October 1, 1935.

Section 4. Determination of parasitic insects sent from locations.

Method of Work: Scientific processing; compilation of card index.

Experimentors: Meyer and Telenga.

Period: Entire year.

Responsible brigade leader on the subject: Dr. N. F. Meyer. Participating

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in the work are: local branch network; Crimean STAZRA, AzSTAZRA, Slaviansk Scientific Industrial Base, Quarantine laboratories, Leningrad-and Abkhaz; VIR with its zonal stations; North-Caucasian Zonal Station, Zonal Station of SPI.

Period: Beginning 1934, to end in 1935.

19. IMPROVEMENT OF BASIC WORKING PARTS AND THE CONSTRUCTION OF MACHINERY FOR THE CONTROL OF PESTS AND DISEASES.

BASIS: Necessity for theoretical experimental testing of basic working parts of machines (mixers, nozzles, conveying parts, pumps, ventilators, etc.) of machinery already in use and that newly constructed.

ANTICIPATED RESULT IN 1935. Theoretical foundation of constructions of principal working mechanisms of machines for the control of agricultural pests and diseases (nozzles, mixers, conveyers, pumps, ventilators, vapor-dust machines).

Section 1. Theoretical and experimental research of basic works of mechanisms of machinery and principles of spraying.

a) Study of spraying; principle of oil spraying (vapor-dust machine).

Method of Work: Study of literature on the construction and preparation of laboratory equipment for the study of the principles of spraying. Laboratory testing of the principle and search of facts for the construction of experimental specimens.

Experimentors: sr. specialist in science engineer Grushevski; participating "Chemsector" (Chemical Sector) (specialist in science Nemiritskii).

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Period: February to August, 1935.

b) Selection of types of manual sprayers.

Method: Laboratory testing, field tests of types of sprayers. Theoretical research on results of tests; compilation of report with all necessary facts for the selection of a type of manual sprayer.

Experimentors: Prof. Iatsenko; sr. specialist in science Abramson;

Period: February to December, 1935.

Section 2. Construction of new machines. Preparation of test specimens of vapor-dust machines.

Method: Development of sketch plan of nodal and working parts, specifications and disabled machinery. Consultation at plants.

Experimentors: sr. specialist in science engineer Snigur, sr. construction engineer Grushevskii and engineer Ternovich.

Period: August to December, 1935.

Responsible brigade leader on the subject: Engineer Khoroshkevich. Participating in the work of the plant "Vulcan".

Period: Beginning 1935, construction of long range nozzle, mixers and conveyers; work to end by 1935. With regard to pumps and ventilators, work to be completed in 1936.

20. TECHNO-ECONOMIC APPRAISAL AND ESTABLISHMENT OF TYPES OF MACHINERY FOR THE CONTROL OF AGRICULTURAL PESTS AND DISEASES, AS RELATED TO VARIOUS TYPES OF BRANCH INDUSTRIES.

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BASIS: Necessity for relative appraisal of machines and recommendation of fundamental types for the various branches of industry. Development of norms and rules for their care.

ANTICIPATED RESULT IN 1935. Determination of type and complex (?) of machines for MTS of grain regions of black earth belt, as well as for old cotton regions; development of norms and rules for the care of these machines.

Section 1. Selection and foundation of types of machines for treating seeds of cotton.

Method: Testing of machines for use with sulfuric acid and formalin. Usual mechanical special phytopathological technique.

Experimentors: VIZRa (sr. specialist in science Meisakhovich), Zak.MIKHI.

Period: January to July, 1935.

Section 2. Selection and establishment of machinery for anti-locust work.

Method: Testing of powerful machines for auto-broadcasting and auto-shifting.

Experimentors: VIZRa (sr. specialist in science Spasskii) and Central-Asiatic STAZRA.

Period: January to December, 1935.

Section 3. Selection and establishment of field machinery for controlling pests and diseases of cotton.

Method: Testing of horse-driven sprayer "ZARA"; the tractor sprayer "Vulcan," and horse-driven sprayer "Vulcan"; the tractor hooded sprayer TN 2.

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Experimentors: VIZRa, SAIZRA, Central-Asiatic NIKHI.

Period: March to December, 1935.

Section 4. Compilation of instructions for the collecting and care of machines TN 2 and C.

Method: Scientific processing.

Experimentors: VIZRa (sr. specialist in science Schmidt, sr. engineer Grushevski.

Period: January to December, 1935.

Section 5. Selection and establishment of type of treatment machinery for dry, half-dry and wet methods of work in grain industry.

Method: Testing of machines "Ideal," "Harvest," "Extra," "Pobeda," Borchard and Popov.

Experimentors: VIZRa (sr. specialist in science Davydov), Voronezh STAZRA.

Period: February to November, 1935.

Section 6. Selection of type and establishment of other machinery for controlling agricultural pests and diseases of grain crops (for the control of ground squirrels, beetle-traps, sprayers, dusters, etc.

Method: Testing of equipment: Pistols (?) Kotliarenko, Galkov, pistol OMVIZRa (Dept. of Mechanization). Dosages for sulfuric slag (?). Preparation of sketch of beetle trap.

Experimentor: VIZRa (Mironov, Bocharnikov).

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Period: January to December, 1935.

Responsible experimentor on the subject: Prof. Iatsenko and dotsent Pervukhin. Participating are Central-Asiatic STAZRA and Voronezh STAZRA.

Period: Subject is transitory, work to be completed in 1935 when complex of machines is submitted to cotton and grain industries.

21. STUDY OF MECHANISM OF ACTION OF INSECTO-FUNGICIDES UPON INSECTS, FUNGI AND PLANTS AND THE BASIS OF THEIR RESISTANCE TO POISON.

BASIS: Summary of scientific basis for the establishment of regularities of connecting toxiferous groups of insecto-fungicides with the nature of their infection of insects, fungi and plants.

ANTICIPATED RESULT IN 1935. Theoretical basis of chemical method.

Section 1. Examination of conditions of appearance of toxic action of different toxiferous groups of intestinal insecticides upon insects and plants.

Methods: Physiological and toxicological research of the action of insecticides upon insect and plant.

Experimentor: Specialist in science Dodonov.

Period: January to December, 1935.

Section 2. Chemical study of insecto-fungicides for the purpose of establishing their toxic action.

Method: Study of several inorganic (sulfur, arsenate) and organic (derivatives of anabasine) compounds of toxicological action from the standpoint of

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understanding their chemical nature in connection with their affecting insects under laboratory and field conditions.

Experimentor: Prof. B. N. Dashkevich.

Period: January, 1935 to February, 1936.

Section 3. Study of conditions of toxic action upon fungi within the grain.

Method: Chemical-toxicological study of fungicides upon fungi and grain of wheat.

Experimentor: Kholodniuk.

Period: February to December, 1935.

Responsible experimentor on the subject: Prof. V. N. Dashkevich. Consultation on methods of entomo-toxicological research of contact poisons, specialist in science Nemiritskii; on methods of entomo-toxicological research of intestinal poisons, specialist in science Dodonov; on methods of physical-chemical research S. A. Glickman; on methods of mico-toxicological research, Prof. N. A. Naumov; participating in the work are: SAIZRa and Azovo-Black Sea STAZRA.

Work to begin in 1934, completion of entire subject in 1937.

22. SEARCH FOR NEW INSECTO-FUNGICIDES FOR THE PURPOSE OF REDUCING THE EXPENDITURE OF DEFICIT POISONS.

BASIS: Decree of SNK of USSR. Necessity for substituting for urgent deficit poisons: arsenic, copper, formalin.

ANTICIPATED RESULT IN 1935. Isolation and recommendation of insecto-fungicides

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and their introduction into production (sulfuric acid, cyanide, derivatives of naptha; poisonous plants; wood gas tar; ("katrelny (?)) dust.

Section 1. Introduction of cyanides of Union production into the field of plant protection.

Method: Laboratory research; field experiments; organization of production tests under field conditions; scientific processing of material.

Experimentors: Specialist in science Il'inskii; participating: VNIIVS, Slaviansk OMIS, Central Laboratory on rodents in Wintering Places. ("Zimovniki"). Institute of Sugar Beet Industry; Institute of Caoutchouc, GruzIZRA (Georgian) UIPI, SPI; to participate - quarantine laboratories (abkhaz and Baku).

Period: May, 1935 to May, 1936.

Section 2. Test of sulfur slab in the control of ground squirrels under different typical conditions of production.

Method: Experimental treatment with mordants of definitely established holes of ground squirrels with sulfur slab of different milling; laboratory study of extraction of hydrogen sulfide from slabs under given moisture conditions. Field timing by chronometer.

Experimentor: Arkhangelskii (Azov-Black Sea STAZRA).

Period: Early 1934, to end August, 1935.

Section 3. Extension of branches of application of hydrogen sulfide method in the field of plant protection.

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Method: Laboratory experiment; test of work under field conditions.

Experimentor: Specialist in science Arkhangelskii, (Azov-Black Sea STAZRA).

Period: Early 1934, to end December, 1935.

Section 4. Acceptance of hydrogen sulfide method in production under various conditions at storage places of different types as applicable in controlling grain tick (mites) (?).

Method: Industrial experimenting under conditions of grain storing in warehouses.

Experimentor: Eidelman (Azov-Black Sea STAZRA)

Period: 1934 to end December, 1935.

Section 5. Study of susceptibility to hydrogen sulfide of seeds of different crops and varieties.

Method: Laboratory tests.

Experimentor: Eidelman, (Azov-Black Sea STAZRA)

Period: 1934 to end December, 1935.

Section 6. Gas-balloon equipment and technique of obtaining liquid hydrogen sulfide.

Method: Laboratory tests. Scientific processing of material.

Experimentor: Dr. Arkhangelskii, aided by Novikov, engineer Ionin (Azov-Black Sea STAZRA).

Period: Early 1934, to end November, 1935.

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Section 7. Development of equipment and dosages of (friable) loose materials.

Method: Theoretical study of problem; scientific processing of plans; preparation of experimental parts; testing of models under laboratory conditions. Tests under industrial conditions.

Experimentors: Novikov, construction engineer Ionin (Azov-Black Sea STAZRA).

Period: Early 1934 to end July, 1935.

Section 8. Obtaining of hydrogen sulfide from aluminum sulfur and magnesium.

Method: Laboratory tests.

Experimentors: Novikov and engineer Ionin (Azov-Black Sea STAZRA).

Period: Beginning July, end December, 1935.

Section 9. Study of absorbent quality of grain and methods of degasification of grain after treatment with hydrogen sulfide.

Method: Chamber gassing with subsequent analysis of grain products. Industrial experiments.

Experimentor: Prof. Arkhangelskii (Azov-Black Sea STAZRA).

Period: January to October, 1935.

Section 10. Study of insecto-fungicide action and reaction upon plants of residues of oil-distilling factories, in connection with their chemical composition and physical-chemical properties and the manufacturing of standard preparations from these residues, based on the study of their composition and characteristics.

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Method: Development of basic chemical method and its rationalization and application in the system of methods for the purpose of substituting for imported and most deficient poisons, and the establishment of optimal dosages.

Experimentor: Ulianishchev.

Period: January to October, 1935.

Section 11. Development of formulas and methods for obtaining caterpillar glue.

Method: Laboratory and lab.-field tests of specimens of glue and experimental work for obtaining new formulas of glue.

Experimentor: Astrakhantsev, P. I.; participating VIZRa.

Period: October, 1935.

Section 12. Study of poisonous plants from the chemical-toxicological standpoint to substitute for lacking insecto-fungicides.

Method: Laboratory experimental work with subsequent testing under field conditions.

Experimentor: Prof. Dashkevich.

Period: January, 1936.

Section 13. Study of industrial residues for the purpose of utilizing them as raw material to obtain insecto-fungicides.

Method: Laboratory experiment work.

Experimentor: Polzik.

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Period: January, 1935.

Section 14. Securing dry cyclones (centrifuges) from gas-like OV.

Method: Establishment of optimal degree of moisture for the saturation of carriers (?) with formaldehyde. Establish by means of curves the disintegration of cyclones at different degrees of moisture and temperature. Toxicological testing. Approval at laboratories and under field conditions.

Experimentor: Blumberg, G. B.

Period: November, 1935.

Section 15. Securing preparations of sulfur and its concentrations in small amounts.

Method: Laboratory and field experiments.

Experimentor: Prof. Dashkevich, B. N.

Period: November, 1935.

Responsible brigade leaders on sections of subjects: cyanides, Il'inskii; naphtha oils, Ulianishchev; hydrogen sulfide, Arkhangelskii; participating: VIZRa, GIPKH, Central-As. STAZRA, AzSTAZRA, Azovo-Black Sea STAZRA; Institute of Aluminum; Institute of Azov Naphtha.

Period: Subject transitory, to begin in 1934, to end in 1935.

23. INCREASE OF EFFICACY AND IMPROVEMENT OF TECHNIQUE OF APPLICATION OF INSECTO-FUNGICIDES FOR THE PURPOSE OF REDUCING THEIR EXPENDITURE.

BASIS: Decree of SNK of USSR. Increase of coefficient of useful action, elimination or reduction of unproductive losses in applied poisons.

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ANTICIPATED RESULT. Determination of indicators, according to which selection of elements (improvers) are made, which increase the stickiness and retention capacity of dust-like preparations; establishment of quantative tests of dust-like preparations and improvers. Determination of physical-chemical and chemical indicators, according to which it is necessary to conduct the evaluation of the suitability of soap and mineral emulsifiers in preparing emulsions from naphtha oils; acceptances of formulas. Establishment of physical-chemical and chemical indicators, according to which it is necessary to produce the selection of naptha oils for the control of pests. Tentative testing of technical methods for obtaining fogs from naphtha oils (vapor-dust method) and setting up of problems subject to research in the field of study of this method. Establishment of limiting dosages of the preparations AB and PD (mordants), depending upon their retention on the grain during treatment.

Section 1. Study of factors reducing the losses of dust-like insecticides and fungicides in their application.

Method: Laboratory experiment.

Experimentor: Sr. specialist in science Sazonov.

Period: January to December, 1935.

Section 2. Study of factors determining the efficacy of naphtha oils in their application in the form of emulsions and fogs.

Method: Laboratory and field experiments.

Experimentors: Specialist in science, Nemiritskii.

Period: January to December, 1935.

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Section 3. Study of conditions of efficacy of dry mordants.

Method: Laboratory and field experiments.

Experimentor: Lovik.

Period: January to December, 1935.

Responsible experimentor on the subject: specialist in science, Nemiritskii.

Participating: KHIMSECTOR (Chemical Sector) of VIZRa, Sector of Mechanization of VIZRa, Slaviansk OMIS, OZRA, VNIIVS, VNIICKHA.

Period: November, 1936.

24. DISTRIBUTION, COURSE OF DEVELOPMENT AND ECONOMIC SIGNIFICANCE OF PESTS AND DISEASES OF AGRICULTURAL CROPS AND FORESTS IN 1935.

BASIS: Decree of NKZ of USSR and VASKHNIL concerning the necessity of compiling an annual survey of pests and diseases for the passed year.

ANTICIPATED RESULT IN 1935. Compilation of seasonal and annual prognoses and surveys of pests and diseases;

Method: Mass-statistical field observations and recording through the network of observation points of S. U., under industrial surroundings, and subsequent statistical analysis of collected material by industrial sectors, with a general summary of the entire material by the Sector of Statistical Recording of VIZRa.

Section 1. Critical analysis of material of SUR for the preceding year for the working out of installations and control figures on the work of the network. Approval and confirmation of plans of work at observation points.

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Method: Scientific processing of material of network.

Experimentors: Volkov, V. F. and industrial sectors of VIZRa.

Period: January to December, 1935.

Section 2. Compilation of review of pests and diseases for 1934, with evaluation of the efficacy of measures in the control and estimate of losses from principal pests and diseases of agricultural crops. To be performed with regard to all operative and most important objects of industrial significance.

Method: Scientific processing of collected data.

Experimentors: SUR(Volkov) and industrial sectors of VIZRa.

Period: April to December, 1935.

Section 3. Testing and additional work on instructive material for the entire network of observation points in 1935.

Method: Instructive directions on all agricultural pests and diseases to be taken into account.

Experimentors: SUR VIZRa (Volkov) and industrial sectors.

Period: February to May, 1935.

Section 4. Securing indicators for the condition of the wintering stages of principal pests. To be performed with regard to ground squirrels, mice-like rodents, locusts, [Loxostega stioticalis] sugar beet weevils, corn borers, cabbage butterflies, apple moths, cutworm moths, pierid butterflies, silkworms, brown tail moths, [Polychrosis botrana Schiff.]

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("grozdevaia lisovertka"), leaf roller moths, rust, and potato tuber rot.

Method: Field surveys of observation points in regions of activity.

Experimentors: Network of observation points.

Period: March to May, 1935.

Section 5. Establishment of periods of development and quantities of pests and diseases, as well as of the degree of injury caused by them to agricultural crops and stored supplies. To be performed with respect to all urgent /operative and economically significant pests and diseases.

Method: Estimate of quantities of pests and degrees of injury caused to crops at stationary and temporary observation points. Surveys, estimates of sexual reproduction of pests and their infection by parasites.

Experimentors: Network of observation points.

Period: Entire year of 1935.

Section 6. Selective estimate of efficacy of measures in the control of pests and diseases of agricultural crops. To be performed with respect to ground squirrels, mice-like rodents, locusts.

Method: Field observation.

Experimentors: Network of observation points.

Period: March to November, 1935.

Section 7. Securing of indicators on harmfulness of principal pests and diseases.

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To be performed with respect to ground squirrels, mice-like rodents, locusts, [Loxostege sticticalis L.], ("lugovoi motylek"), the complex(?) of leaf-gnawing and sucking aphids on vegetable and technical crops, leaf-eating pests of legumes, club root of cabbage, leaf roller moth, rust of grain crops, scab of apple, mildew and oidium of grape, gummosis of cotton, diseases of flax.

Method: Stationary estimate of quantity and degree of injury of crops, and estimates of harvests on damaged and undamaged plots.

Experimentors: Network of observation points.

Period: April to October, 1935.

Section 8. Securing of indicators on the size of wintering supply of principal pests and agricultural diseases at state and collective farms of the USSR. To be performed with respect to ground squirrels, mice-like rodents, locusts, [Loxostege sticticalis L.] ("legovoi motylek") sugar beet weevils, cutworm moth, and other sugar beet pests; ("Karadrina") [Laphygma exigua Hb.]; ("Khlopkovaia Sovka") [Chloridea obsoleta, F.,] complex of leaf-gnawing pests of vegetable and technical crops; ("gorokhovy slonik") Curculionidae and aphids on peas, cotton and cereals, red spider, [Tetranychus urticae Koch.], on cotton, [Chloridea obsoleta F.,] ("khlopkovaia sovka"), cabbage butterfly, complex(?) of pests of garden crops, smut, apple and pear scab, gummosis of cotton, warehouse and supply pests.

Method: Prior and following processing estimates to be made of yields on cultivated and non-cultivated plots.

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Experimentors: Network of observation points.

Period: June to November, 1935.

Section 9. Compilation of summaries on the condition of wintering stages of principal pests and compilation of seasonal summaries. The latter concern mice-like rodents, locusts, [Loxostege sticticalis] ("lugevoi motylek"), [Agrotis segetum Schiff.] ("ozimaia sovka"), cutworm moth; [Chloridea obseleta F.] ("Khlopkovaia sovka"), [Laphygma exigua Hb.] ("Karadrina"); Hessen fly, storage pests, rust, ergot, potato rot, phytophthora.

Method: Field survey and subsequent scientific processing of material.

Experimentors: Network of observation points and industrial sectors of VIZRa; Sector of Statistical Recording Service of VIZRa.

Period: April to November, 1935.

Section 10. Compilation of review of spread and development and economic significance of pests and diseases of agricultural crops in 1935, with prognosis on the expected development of the most important among them in 1946. Applicable to all recorded objects.

Method: Scientific processing and literary presentation of material.

Experimentors: Network of observation points and indsutrial sectors, and Sector of S. U. VIZRa.

Period: October to December, 1935 and 1st quarter of 1936.

Section 11. Compilation of losses from pests and diseases and determination of

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efficacy of measures in controlling them in 1935. Conducted with respect to the principal economically significant objects; estimate of efficacy of measures with respect to urgent major objects.

Responsible experimentor on the subject: Volkov, V. F.

Period: Subject annual.

25. WORKING OVER AND REVISION OF STANDARDS IN INSECTO-FUNGICIDES.

Method: Laboratory experiment.

Experimentor: Prof. B. N. Dashkevich.

Period: October 1935.

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SECTION III

SUMMARY OF EXPERIENCE OF VIZRa AND ITS NETWORK OF SCIENTIFIC RESEARCH INSTITUTIONS ON PLANT PROTECTION IN THE USSR AND ABROAD

Nos. in their order	Project	Participants	Person in Charge	Date
1	Securing reports from branch institutes and Stations of Plant Protection for 1934; their analysis; preparation of card index on accomplishments and results of 1934.	All sectors and laboratories of VIZRa	Specialist in science	July 1
2	Generalization of experience of work of advanced state and collective farms and MTS in the field of plant protection from the standpoint of correctness of application xxxxxxxxxx of scientific accomplishments and efficacy of applied methods. The result of this work will be demonstrated in a series of proposals made to the Main Administration of NKZ and functioning organizations with respect to shortcomings in the organization of pest control at state and collective farms and MTS, and in recommendations made by advanced farms of operative organizations.	Observation points of Record Service and Sector of Record of VIZRa, Azovo-Black Sea, Central-Asiatic and Voronezh STAZRA.	V. F. Volkov	December 15
3	Generalization of summarized work of VIZRa, its network and branch institutes for the preceding years by the compilation and publication of summaries and monographs.	All sectors and laboratories of VIZRa.		
	a) on [Loxostege sticticalis L.] ("lugovovoi motylek")		Specialist in science A. B. Znamenskii,	October 1936

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Nos. in their order	Project	Participants	Person in Charge	Date
	b) on [Parausta nubilalis Hb.] ("Kukuruzny Motylek")		Dr. V. N. Shchegolev	July, 1936
	c) on [Agrotis segetum Schiff.] ("ozimaia Sovka")		Specialist in science I. V. Nikitin)	End 1935 - 1936
	d) on smut		Specialist in science P. A. Proida	End 1935 to 1936
	e) on rust		Specialist in science N. A. Naumov	"
	f) on fusariums		Railo and S. N. Tupenevich	"
	g) on locusts ("tochilshchiki")		Specialist in science G. Ia. Bei-Bienko	
	h) on [Stegobium Anabiidae]/ All Sectors and laboratories of VIZRa. ("tochilshchiki")		Dr. V. N. Stark	"
	i) on [Elateridae] ("provolochniki") wireworms.		Specialist in science G. N. Iaroslavtsev	"
	j) on gummosis of cotton		A. S. Letov	"

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Nos. in their order	Project	Participants	Person in Charge	Date
	k) on mice-like rodents		Specialist in science S. I. Obolenskii	End 1935 to 1936
4	Summary on pests and diseases of forests of Kirghiz ASSR	Sector of woody genera crops of VIZRa	Sr. Specialist in science Parfent'ev	May, 1935 to Jan. 1936
5	Summary on house fungi [Merulius lacrymans Schum.]	Sector of woody genera crops of VIZRa	Sr. specialist in science Sokolov	Nov., 1935 to Feb. 1936
6	Summary on parasites of gypsy moths [Bombycidae]; analysis of its degree of infection by parasites.	Bio-Laboratory of VIZRa	Dr. N. F. Meyer, Telenga and Radendorf	May 1935 to Jan. 1936.
7	Summary of the distribution and economic significance of pests and diseases of agricultural crops and forests for 1930 to 1934.	Sector of Recording Service	Specialists in science Iaroslavtsev and Proida	July 1935
8	Compilation of regulations on plant protection.	Branch sectors of VIZRa and Sector of Statistical Service.	I. A. Zelenukhin, Director of Institute	October 1935
9	Compilation and publication of monographs on summaries of Soviet and foreign science on plant protection	All major USSR scientists in field of plant protection.	Prof. N. N. Bogdanov-kat'kov	1935 to 1937

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SECTION IV

ADVANCE OF SCIENTIFIC ACHIEVEMENTS IN THE FIELD OF PLANT PROTECTION INTO AGRICULTURAL PRACTICE

Nos. in their order	Project	Participants	Person in Charge	Date
1	Organization at collective farms and MTS of Northern Caucasus, Azov-Black Sea and Ukraine, 5 laboratories on propagation of the parasite trichogramma to aid in the control of corn borer [Pyrausta nubilalis Hb.].	VIZRa, Grain Administration of NKZ; Territorial (oblasts) of ZU and observation points of Statistical Recording Service of VIZRa.	Dr. M. F. Meyer	Feb. to Dec. 1935
2	Guidance and organization of control with the aid of hydrogen sulfide of storage mites in warehouses of Zagotzerno of Azov-Black Sea and North Caucasian territories, as well as of Moscow railroad system.	Azovo-Black Sea STAZRA, Institute of Grain Industry, Zagotzerno (Stored Grain), Bread Inspection	Dr. Arkhangelskii	Feb. to July 1935
3	Establishment of wide scale industrial experiments at MTS and collective farms of Azovo-Black Sea, relative to application of hydrogen sulfide and sulfuric aluminum in treating seeds with mordants from smut, and in the control of ground squirrels ("susliki").	Azovo-Black Sea STAZRA, Azovo-Black Sea Territory	Dr. N. N. Arkhangelskii	March
4	Organization and guidance of works on application of naphtha oils in the control of San Jose scale ("shchitovki") in Azov-Black Sea Territory and Azerbaidjan.	Azovo-Black Sea and Azerbaidjan STAZRA, Slaviansk, CPIS, southern Fruit Institute, Azov-Black Sea Territorial ZU, Azerbaidjan NKZ.	Specialists in science D. G. Nemiritskii, and Ulianishchev	March - December 1935
5	Transfer of products of auto-broadcasting attractants to the factory "Vulcan" and their testing under industrial conditions.	Sector of Mechanization of VIZRa	Engineer I. P. Iatsenko	March to Nov. 1935

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Nos. in their order	Project	Participants	Person in Charge	Date
6	Compilation of instructions and rules for the care of auto-sprayers "Pioneer;" provision of work norms.	Slaviansk OMIS and Sector of Mechanization of VIZRa, plant "Vulcan"	Grigoriev	April 1935
7	Introduction into industry of measures for the control of [Pyrausta nubilalis Hb.] (corn borer) ("Kukuruzny Motylek").	VIZRa, Administration of Flax and Hemp, Grain Administration of NKZ of USSR, hemp growing and grain MTS, and state farms.	Dr. V. N. Shchegolev	April to December 1935
8	Compilation and publication of prognosis on pests and diseases for 1935.	Sector of Statistical Recording Service of VIZRa and branch sectors.	Iaroslavtsev, and Proida.	March 1935
9	Provision of short term prognoses supplied to Main Administration of NKZ concerning mass outbreaks of most important pests and diseases in 1935 of [Loxostege sticticalis L.] ("Lugovoi motylek"), locusts, cutworm moth [Agrotis Segetum Schiff.], field mice, mildew, etc.	Sector of Statistical Recording Service of VIZRa.	Iaroslavtsev, Proida and	March - October, depending upon pest.
10	Aid and consultation of functioningorganizations on problems of pest control through scientific-industrial magazine of VIZRa "In aid of Yields."	Authors' Collective and all contributing members of magazine.	I. A. Zelanukhin	January - December 1935.
11	Compilation of instructions for collective and state farms and MTS on measures of controlling the following pests:	VIZRa	S. I. Obelenskii	February - March 1935.
12	a) on rodents in populated points	"		
	b) on mice-like rodents under field conditions.	"	O.N., Bocharikov	"

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Nos. in their order	Project	Participants	Person in	Date
	c) on ground squirrels in endemic regions.	VIZRa	Obolenskii	Feb., March, 1935.
	d) on application of hydrogen sulfide in control of mites, ground squirrels and	"	Prof. N.N. Arkhangelskii	"
	e) on outworm moth [Agrotis segetum Schiff.] for south, western and north-eastern regions of European USSR.	"	Spec. in Science I.V. Nikitin	"
	f) on [Pyrausta nubilalis Hb.] corn borer;	"	Dr. V. N. Shchegolev	
	g) on treating cotton seeds with mordants	"	Spec. in Science A. S. Letov	"
	h) on protecting useful insect-eating birds in gardens.	"	Sr. Scientific worker A. B. Kistiakovskii	"

Director I. A. Zelenukhin

Scientific Secretary Dr. V. N. Stark

END OF BOOK

4/13/51

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Gusev, V. I.
In the Scientific Soviet VIZR. (All-Union Institute for Plant Protection) Vest.Zashch.Rast. 1940(1/2): 276-277.
1940. 421 P942

Translated from the Russian by
Rosa G. Dembo

At the session of the council November 19-25, 1939, reports were heard of the candidates Mach and V.P. Borisov for the period of studying towards degree, report of B. A. Lipsky, Assistant Director of Leningrad Stazra (Station for Plant Protection), on the sum total of scientific investigating work of the station for the year 1939 and on the plan of work for 1940 and also the report of I. M. Poliakov, Assistant Director of VIZR, Scientific Part, on the plan of scientific research works of VIZR for 1940.

In his report candidate G. E. Mach discussed mainly the work for the last 1 1/2 years on the topic "specific differentiation of wasps("skeliia") [Vespoid digger wasps, Scolia], their biology and the possibility of using the biological method of controlling the cockchafer [Polyphylla sp.]. The report of comrade Mach provoked a lively exchange of opinions. The scientific council of the Institute accepted the work as a sum-total and recommended comrade Mach to present it as a dissertation for the degree of Candidate in Science.

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Lively discussions were provoked by the report of candidate V. P. Borisov in which he discussed three works: 1) the determination of the character of the action of various insecticides for winter application against the complex of pests; 2) activization of emulsions of lubricating oil which has as its aim the creation of an insecticide which possesses the ability of destroying a maximum of pests residing in winter on the bark and on the branches of trees. In 1937-1939 some of the activated emulsions which were prepared were applied on collective and state farms and gave definite results; the study of the connection between chemical structure of substances and type of application of their specific toxicity.

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Gusev, V. I.

As it has been clarified from the report of B. A. Lipsky, Assistant Director of Lenstazra (Leningrad Station for Plant Protection), the work of the station in 1939 passed into three directions: 1) the working out of separate measures and of their complex in the control of separate pests and diseases of agricultural plants, which have in this field agricultural importance of the first degree, the spider-net tick (Tetranychus unticae) on cucumbers; bacterioses of cauliflower; decay of seeds of fodder cabbage; carrots and turnips; brown spottiness of tomatoes; shwedskaia mukha (Oscinella); granary tick; stem nematode of onions and oth others; 2) revealing the spreading of main pests and diseases of agricultural plants with the long-term and short-term forecasting of their appearance; and 3) organization for assisting farms in the protection of plants and introduction of new control methods for pests and diseases of agricultural plants. There is at Stazra also an industrial laboratory for brewing and for application of trichogramma.

For the year 1940 Stazra outlined for working out topics concerning development of measures for control of: wire-worms, pests and diseases of seeds of the mustard family (Cruciferae), of winter owlet moth on vegetables; diseases of cucumbers, of granary tick and of other granary pests under collective farm conditions; besides, the plan provides an industrial verification of the effectiveness under collective farm conditions of measures in controlling smut of grains, the work of registering and on the drawing inferences from the experiment of stakhanovites in control of pests and diseases of agricultural plants.

After the report of I. M. Poliakov concerning the plan of work of VIZR for 1940 the Scientific Council heard the reports of scientific instructors on these topics which gave the basis and the expected results on the topics. As objects of study there is included into the plan of VIZR for 1940 the study of the

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Gusev, V. I.

following pests and diseases of agricultural plants; the rust and black of canker of seed plants; phytophtora of potatoes; decay of grain roots; wilt of agricultural plants; phylloxera of grapes; Asiatic and Moroccon locust; wire-worms; darkling beetles and cockchafer (may beetles?); pests and diseases in the Farthest North, mouse-like wood-beetle (rodent?) and suslik (ground squirrel, Citellus Citillus), dusty and hard smut; sugar beet weevil; harmful eurygaster, bacterioses of wheat, barley, oats and potatoes; viruses of Solanaceae and of Malvaceae plants; storage pests; pests and diseases of seed-bearing fruit crops.

The following topics also are included in the outline of the scientific investigating work of VIZR for 1940 which is presented for approval; on the phytopathological basis of selection and methods of appraisal of plants based on their resistance to diseases; on biological methods of control; on classification of most important fungi in agriculture; on mechanization of control of pests and diseases; on selection of insecticides based on the investigation of new preparations; on kerosene and coal oils; on methods of increase of effectiveness of poisons; on industrial testing of new preparations in control of pests and diseases of agricultural plants, on working out of methods of soil fumigation based on the study of the dynamics of fumigants in the soil; on working out of new fungicides, on study and of application of physical agents for the control of pests and diseases of agricultural plants.

April 25, 1951

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Declassified and Approved For Release 2013/03/25 : CIA-RDP80R01426R009900010001-5

Elsukev, M. P. (Transl. 85; Plant Protection)

Basic problems for agricultural plant protection against pests and diseases during the Third Five Year Plan.
Vest. Zashch. Rast. 1939 (1): 9-14 1939. 421P942.

Translated by P. Dembo

At the 18th Congress of VKP(b) (The All-Union Communist Party) Comrade Stalin depicted a vivid picture of the achievements of socialist agriculture. In his report he said: "Our agriculture, therefore, appears to be not only the largest and the most mechanized, hence, the most commercial agriculture, but is an agriculture which is better equipped with contemporary techniques than the agriculture of any other country."

During the third Stalin Five Year Plan the 18th Congress outlined great perspectives in the development of the agriculture of the USSR. The third Five Year Plan foresees a growth of agricultural production from 20.1 billion rubles to 30.5 billion rubles, namely an increase of the total yield of agricultural production of 52 percent. It has been planned to collect in grains 8 billion poods at the average of 13 centners per hectare: in sugar beets - 282 billion centners from the average crop of 235 centners per hectare, in cotton - 32.9 billion centners at the average crop on irrigated sections of 19 centners per hectare; in flax - 8.5 billion centners at the average crop of 4.6 centners per hectare. Thus during the third Five Year Plan our great agriculture equipped with the most advanced technique will provide the land with agricultural products in plenty.

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The greatest achievements of socialist agriculture which have been demonstrated at the all-union agricultural exhibit, indicate that under our very eyes the foresight of Engles is being fulfilled, that with the socialistic organization of society will start a new historical epoch, in which people, and together with them all the branches of their activity, and particularly in natural sciences, will

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accomplish so much that everything which has been done up to that will appear only as a mere shadow." (K. Marx and F. engels. Complete Works, v. XIV, p. 488)

In order to fulfill the great problems foreseen by the outline of the third Stalin Five Year Plan, we must mobilize all our strength, all our energy, all our scientific knowledge. Particularly, is it necessary to liquidate rapidly that great damage which has been brought upon all agricultural crops by harmful insects and diseases.

The statistics of Tsarist Russia counted the damage done yearly to agriculture by insects and diseases in a minimum of 2.5 billion rubles. As a result of economic and social conditions of the prerevolutionary period, the protection of plants at that time consisted of separate, planless measures, which were done mainly on the lands of the landlords, insignificant in their scale and entirely ineffective in their results. The control of pests and of diseases in agriculture as a system of governmental measures was absent at that time.

The socialist form of agriculture permits the fulfillment of the planned system of governmental measures in the protection of plants against pests and diseases, which consists of the harmonious and interrelated complex of agrotechnical, chemical, biological, physical and mechanical methods of control. In the conditions of the planned socialist economy there exists a full possibility of carrying out all these measures on large areas at the same time.

The amount of loss caused by pests and by diseases to agricultural plants decreases in USSR with each year, although it is still quite significant. For instance, during the period from 1934 to 1938 there died from Bothynoderes punctventris Germ. (sugarbeet weevil) more than 300,000 hectares of sugar beets, in

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cotton there is an annual shortage in yield of 14-15 percent caused by parasites and diseases; in 1938 the areas contaminated by locust reached 200 thousand hectares and so forth. Therefore, the attention of governmental, party and social organizations should be directed towards the extermination of the same. For this extermination during the years of the revolution we prepared the necessary prerequisites.

The steady increase of cadres in plant protection particularly warrants this extermination. In prerevolutionary Russia there were very few research institutions. Now there are in USSR more than 100 scientific research institutions which work in this field. This increase is a direct result of the widely developed measures in the control of agricultural plants in our country, caused by the increase of the demands of production.

Besides the special scientific instituions, the research work which developed in the laboratories of collective farms attracted the minds of thousands of collective farm specialists.

In 1859 there were in Tsarist Russia only 3 or 4 entomologists. Now there are more than a thousand. The specialists, entomologists and phytopathologists, work now not only in regional and oblast agrarian institutions, but in district agrarian organizations and at machine tractor stations as well.

Due to the constant increase of the cadres of the workers in the protection of plants there is at the same time an improvement in the quality of their preparation.

The further training of the cadres in the protection of plants should be developed not only at the universities, but also in mass instruction of squads on

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state and collective farms and by retraining of the agronomic personnel at courses of applied zoology and phytopathology. For the matter of plant protection it is necessary to attract that great army of agronomists which is directly engaged in production. It is necessary to discontinue the aloofness in the matter of plant protection which occurs on the part of agronomists, since the protection of the crops against pests and diseases is one of the most important agronomic procedures in increasing the yield capacity.

There has been a considerable change in the direction and in the contents of the scientific research work in plant protection. In the past research limited itself for a long time to the morphological study of the object itself, without taking into consideration its relationship to the environment. For a long time the problems of ecology were neglected due to the prevalence of morphological methods of work. At the present time the study of pests and diseases has been conducted in its relationship to the environment. Ecological explorations supply a foundation for agricultural entomology and phytopathology which became to some extent agronomical sciences. The methodology and the technique of investigation changed considerably as well. Thus, if before the revolution the basic mass of explorers applied mainly the method of direct control and of the stating of facts, now along with control the entomologists and phytopathologists turned to the method of intensive laboratory anf field experimentation and to industrial inspection of the results of the experimentation in the conditions of the collective and state farms. From stating and fixing of facts they turned now to a deeper analysis and to a detailed deciphering of all the complicated interrelationships of all insects under study with the environment, the reaction of plants to their injuries, the clarification of the relative role of separate factors of this environment in the dynamics of the development and of the propagation of insects and diseases.

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These most important qualitative and quantitative shifts which occured in the field of science in plant protection after the October socialist revolution gave the opportunity of obtaining a series of very valuable achievements which had a great significance in a wide branching out of measures and in the reduction of losses from pests and diseases. The biology of a series of pests and diseases of plants has been scrutinized. The biological data that were obtained are placed on the basis of the measures in plant protection in USSR. An all-union quarantine job has been organized which decreases the danger of the penetration into the USSR of some new kinds of pests and diseases. Our achievements and perspectives in the field of mechanization of plant protection against pests and diseases is great. Based on the work of research organizations there exists at the present time a powerful apparatus, created by soviet designers and produced in soviet factories. There has been found and tested an assortment of poisons for the control of pests and diseases and there is a considerable increase in the application of those poisons. Thus, in prerevolutionary Russia the expenditure on the control of pests in agriculture amounted to only 8,700 tons of chemicals, which were mainly imported, while in 1936 this quantity increased to 50,000 tons, the poisons being prepared since 1930 entirely by our chemical industry. A biological method of control of pests has been scientifically worked out and has been widely and successfully applied. The aerochemical (airplane spraying?) method has been scientifically well-established and widely applied for the purpose of control of agricultural pests. Already at the beginning of the second Five Year Plan we had our own insecticides and fungicides and freed ourselves fully from importing them. Since 1917 there has been worked out a series of new methods of control of pests, and some of the previously known methods have been improved, rationalized and in a series of cases have been incorporated into the operative practice as branched complex systems of measures.

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Nevertheless, along with the positive sides just mentioned, we still have a whole series of most important shortcomings. These shortcomings obstruct the labor of our collective and state farms. Science undoubtedly lags behind considerably as far as the demands of industry are concerned. Many very dangerous harmful insects apparently have not as yet been explored. For instance, there have not been worked out as yet any radical methods of control of such pests as little turtles [Eurygaster], wireworms, darkling beetles [Tenebrionidae], Swedish fly [Oscinosoma frit L.], Hessian fly [Mayetiola destructor Say] and a series of other species. There have not as yet been worked out sifficiently measures of control of pests and diseases of alfalfa and clover. It is necessary to liquidate in a short period of time this lag in science as far as the study of pests and diseases is concerned.

The protection of socialist yields from pests and diseases on the huge area of crops in the USSR by a correct organization should undoubtedly give quite perceptible results. Comrade Molotov in his report at the 18th Congress of VKP(b) (the All-Union Communist Party) concerning the third Five Year Plan of the development of agriculture in USSR said, that "in the third Five Year Plan there are opening for progressive soviet science most favorable opportunities." Therefore the problem of the correct organization of scientific investigation work in plant protection against pests and diseases appears to be most urgent.

From day to day there are growing new persons, specialists, innovators in scientific-exploring institutions, in universities, at laboratories of the collective farms and on the fields of state and collective farms. The years of Stalin Five Year Plans are the years of the victory of cultural enthusiasm of the entire nation. "As a result of this tremendous cultural work there originated and has been formed a numerous new soviet intelligentsia, which comes from the lines of the

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labor class, peasants, soviet workers, the very blood of our people - an intelligentsia, which does not know the yoke of exploitation, which hates the exploiters and which is ready to serve the people of USSR faithfully and truthfully." These cadres, undoubtedly, will be able to ensure the further development of science in plant protection.

The second shortcoming in the matter of plant protection is that during the two first/Five Year Plans the work has been done only in the direction of protection of crops from pests and diseases. The measures did not ensure the liquidation of the basic focuses of its propagation. Now, in relationship with the growth of mechanization of work in plant protection on which much labor has been spent, with the development of chemistry, under the conditions of high agricultural techniques, etc., with respect to a whole series of pests and diseases it is possible and it is imperative to place the problem of losses to an insignificant scale by shifting from defense of crops to attack, that is to the liquidation of pests and of diseases not only on the fields, but in their basic focuses of propagation as well.

The third shortcoming of the organization of the work in plant protection is the insufficient planning of research. The planning of all work, as it is well known, is one of the most important conditions of socialist construction. During the third Five Year Plan the principles of planning in plant protection should have mainly a composite character. It is necessary to attract to the solution of one problem or another not only the scientists of various related disciplines, but workers in cottage-laboratories, collective farmer-Stachanovites as well.

At the planning of the scientific-exploring work in plant protection, according to our opinion, it is necessary to take into consideration the following basic positions.

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All the work must have as its aim: on one hand - to increase the resistance of agricultural plants to injuries, and on the other hand to work out some methods and measures of direct liquidation of pests and of diseases. These two directions of explorations are closely interwoven. It is imperative to intensify the work in the field of surveying such agrotechnical methods which could check the mass propagation of insects and of diseases. It has been sufficiently proved that the mass propagation of insects and of diseases is closely and constantly related to a series of climatic and meterological conditions, to the presence of some kind of food, to the structure and activity of the enemies and diseases of insects which itself is determined frequently by agricultural conditions. In the conditions of the environment, which depends on agronomical technique there are a series of factors, which are able to check the excessive propagation of insects and which keep them within the limits of harmlessness. But as soon as these conditions change in the direction beneficial for the pests and diseases, then occurs rapid propagation and wide distribution of pests and of diseases and the intensification of their harmfulness.

The above indicated underlines the necessity of complex all-sided investigation. The academician V. R. Williams in one of his articles in 1938, "Against the crawling Empirism in the scientific-investigating work," Pravda No. 342, 13/XII, 1938, wrote: "Scientific-research institutions and especially experiment stations up to recent times ignored the indisputable attitudes of dialecticism that all the conditions or factors in the life of plants are organically interrelated and that a mechanical gap or an underestimation of one of the factors results in serious changes, which disturb the qualitative and quantitative expression of that or other process."

Except for the complexity in the construction of blue-prints of the exploring works, it is imperative to aspire towards a detailed understanding of the conditions

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of mass propagation of pests and of diseases. The mass appearance of insects and the development of diseases usually does not originate at once, but grows gradually. It is understood that the measures for checking must be carried out not only in the years of their mass appearance, but first of all in the years and in the districts when the pests and the diseases just begin to threaten the crops. The liquidation of pests and of diseases is especially valuable for practical reasons, when it is carried out in places of their first reservations. In connection with this the work of prognosis is of most importance, explorations of the theories of mass propagations and of the method of registration of insects and of diseases.

The next premise must be that the checking of pests and diseases should first of all have a prophylactic character. For an efficient application of those or other measures for the aims of prophylactics it is necessary to know in detail the way of life and the development of various pests and diseases in order to direct the checking measures against the vulnerable sides of their life in time.

Taking into consideration the above indicated basic approaches, the plan of scientific-research work of VIZR (All-Union Institute of Plant Protection) provides: 1)a deep study of causes and conditions of mass propagation and of diminution of especially multi-poisonous pests and diseases, with the aim of finding measures of checking them and of increasing effective measures; 2) the working out of efficient methods of checking pests and diseases of agricultural crops and 3) the instillation of mechanization into all processes of plant-protection.

Based on that, the plan will be built during the third five-year-plan according to the following basic problems:

1. A deep bio-ecological exploration for the ascertainment of causes and of conditions of mass propagation of pests and diseases and for the basing of measures

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for their checking. As the result of working out this theme at the end of the Five-Year-Plan, along with the affirmation of causes and conditions of mass propagation, there should be found concrete and radical measures for checking, and also should be obtained some data on spreading and the harmfulness of basic pests and diseases. Here should be worked out the methodology of a long-range forecast of the appearance of most important, most dangerous pests and diseases.

2. Instillation of a biological method of checking of pests and diseases, a theoretical foundation and a further working out of this method. We trust that a wide application of such parasites and pests, as Trichogramma, Telenomus, Chilocorus, Cryptolaemus, Coccinellidae, and also bacteria of the gallery type and others, after a scientific exploration and a wide instillation will give enough effective results in the decrease of the loss of crops from pests.

3. The study of possibilities of application of physical agents for the checking of pests and diseases of agricultural crops. Here we have in mind investigation with the aim of controlling pests and diseases by such physical agents as light, thermal energy, electricity, various types of radiation, ultra-sonic vibrations, etc. It is intended to evaluate the effectiveness of the indicated agents in the matter of checking pests and diseases of various agricultural crops and as to separate kinds, to test them in the control of meadow-moth, winter crop owlet moth [Noctuidae], Phylloxera, fruit-pests, storage-pests, etc.

4. The study of principles of action of chemicals upon insects, fungi and cultivated plants, a working out and establishment of new insectofungicides, which are provided by raw-material base in USSR and which have a complex action. It is intended to concentrate the attention mainly upon plant poisons, condensates, caterpillar glue, coal-tar and mineral oils, etc. In the field of improving methods of

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application of insecticides it is intended to take into consideration the application of colloid solutions, improved preparations, formation of clouds, etc. Special attention should be given to the study of a chemical method of checking soil pests by means of depth and surface soil fumigation. All the insecticides and fungicides have to be widely approved under the conditions of production, their standards have to be worked out and specified.

5. The installation into production of new approved constructions of machines in the checking of pests and diseases of agricultural crops, the study of mechanisms, of action of separate units with the aim of creating most effective constructions. In particular it is intended to pay attention to the installation of new types of mordant machines, tractor-sprinklers, new types of point-protectors, of automatic-mixers and scatterers of baits, refinement and approval of universal pollinators, creation of new perfect and effective complex constructions.

6. A theoretical foundation of selection based on the resistance of agricultural plants to pests and diseases. Based on that there should be made explicit the principles and methods of evaluation and of alteration of various varieties and a scientific foundation of resistance of varieties to various types of diseases should be given.

7. Coordination of all-union and world experience on separate matters which have a considerable negative significance. Here is intended to compose a series of monographs and scientific appliances and in the first place on covered (?) and loose smut, fusarium, gummosis, diseases of vegetables, sugar-beet weevil, eurygaster, Phylloxera and others, in mechanization, in chemical methods of control.

8. An important division in the work of VIER is the introduction into the production of available achievements in past work, such as: in biological method

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of control and, especially, of mechanization in the matter of plant control, where VIZR has already at its disposal a considerable material which has been worked out and verified.

Such is in general features the plan which has to be worked out by the net of VIZR in the third Five Year Plan. That plan can be executed and thus an answer to production could be given, if in the execution of the most important divisions the complex method will be realized.

On all scientific-research works it is absolutely necessary to have an all-union plan, in which the work of all organizations for plant control (VIZR, branch institutes, stations for plant protection, selection stations, universities) should be united. In the work of all scientific research there should be a specific direction. In the presence of such indivisible all-union plan of scientific research we undoubtedly will liquidate the duplication which often takes place. Over the creation of such a unified plan first of all should work the Section of Plant Protection of the All-Union Academy of Agricultural Sciences named after V. I. Lenin.

It is imperative to place at the proper level a network of estimating services with the aims of forecasting and warning of the development and propagation of pests and diseases, widely incorporating into this work the laboratories of collective farms. Up to now the work on calculation was organized in an entirely unsatisfactory manner.

It is imperative that the operating organizations would use the achievements in science for production - in state and collective farms - as fast and as boldly as possible.

All the problems which plant protection is facing are not exhausted by the

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above indicated. The solution of these problems will require a summary of a highly theoretical basis. On the pages of our magazine it is necessary to open a wide critical discussion of a series of basic theoretical problems underlying the matter of plant protection. It is necessary to repulse all those pseudoscientific and in reality harmful theories in plant protection, as for instance the theory of biological equilibrium, etc. We challenge our scientific workers to express their opinions in these problems on the pages of our magazine. All the divisions of science in plant protection should not isolate themselves into limited spheres, they should be worked out on a wide general biological foundation, on the foundation of the evolution theory of Darwin, in the spirit of Marxist-Lenin dialectics.

The workers in plant protection are faced with an honorable and responsible problem - to promote to the utmost the increase of yield at the expense of the elimination of losses from pests and diseases. There is no doubt that this task will be accomplished with honor.

In the execution of this task, undoubtedly, the new magazine, "Bulletin of Plant Protection," will be of greatest importance. The magazine has as its aim the struggle for advanced science in the field of plant protection. By means of publication of the newest achievements in plant protection, obtained in exploring institutes and by stakhanovites on collective farms, the magazine will strive toward the most rapid assimilation of the same by agricultural production. On the pages of the magazine it is necessary to open an active criticism of harmful theories pertaining to plant protection, it is necessary to give a series of methodological articles with the aim of rationalization of scientific investigation works in plant protection.

We call upon all workers in plant protection for an active participation in the magazine.

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Elsukov, M. P., and Piatnitskii, G. K.
Concerning the tendency of the scientific-research work on plant protection. Vest. Zashch.Rast. 1940(1/2): 8-14. 1940 421 P942

Translated from the Russian by
Rosa G. Dembo

According to the data of pre-revolutionary statistics, the losses, caused yearly to agriculture by pests and diseases amounted to a minimum of 2 1/2 billion rubles. But the conditions of that time summed up the measures in plant protection to some odd, planless, and insignificant kinds; plant protection as a system of state measures did not exist at that time, its results were hardly noticeable.

The socialistic form of agriculture incorporates into the basis of planned, organized plant protection a unified system of state measures which is carried out by applying the entire complex of agrotechnical, chemical, biological, physical and mechanical methods of control. Nevertheless the quantity of losses caused in USSR by pests and diseases to agricultural plants remain still quite significant.

One of the causes of such a situation consists in the fact that the present condition of the problem of plant protection does not ensure in most parts the obtaining of a lasting control, because it is based primarily upon measures of direct forcible destruction of pests, by one or another means, in places of their greatest settling. At the same time the destroying measures, as it is shown by the analysis of the whole work in plant protection, are in most cases little worked out theoretically and are empiric. The weakest spot is the basis for the form, timing and the technique of application of those measures by concrete knowledge of conformities with the development and behavior of the insect or of the parasite in relation to the conditions of the environment and particularly in relation to the protected crop. In connection with this the measures of control has all the time the character of standard formulas artificially con-

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nected with general agriculture verified for some particular cases and little adopted for wide use. In close connection with this the existing measures sometimes become insufficiently effective and at the same time they are too huge and expensive.

All these shortcomings could be demonstrated by the example of the sugar beet weevil [Bothynoderes Punctiventris] - one of the basic and oldest posts of sugar beets. The history of study and of the working out of the mechanical method of control goes as far back as 100 years, that of the chemical method - 40 years, and thus could serve as the indication of the general condition of these methods of control in the matter of plant protection. Nevertheless, according to the investigations of VIZR (All-Union Institute of Plant Protection) in 1937-1939 the effectiveness of the applied form of mechanical control of the sugar beet weevil does not exceed 40-50% of the necessary and the possible, since the control does not incorporate fully the constant settling of the insects in the sugar beet crops-rotation (since they were unknown until recently) and the system of recommended nets of barrier ditches (district and small ones) and the norms of maintenance of the same, established without any fundamental study of distances and of directions of the marching of the beetle, allow the unhindered escape from winter nests and resettling of at least 30-50% of the beetles.

In equal degree the chemical method of control of the sugar beet weevil appeared to be essentially undeveloped, of little value and little effective, since it was not in sufficient degree founded on the necessary objective bio-ecological indicators and conformities (particularly with regard to the regularity of the terms of the settling, maturing and the ovipositing of the beetles, the length of retention of poisons upon the plants and the necessary multiplication of works connected with it, etc.) At the same time these data could only

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ensure the development and the transmutation of the mainly general and primitive-empirical scheme of the application of the chemical methods against sugar beet weevil which existed until recently and which is differentiated in applying to the main types of concrete natural conditions. And as a result of all this in spite of the tremendous growth in volume of chemical and mechanical control, the quantity of sugar beet weevil and the losses caused by it did not show any tendence to decrease in the last three years. The example with sugar beet weevil is not a solitary instance. In the same situation is the problem of control by means of destroying methods against phylloxera, winter owlet moth (Agrotis segetum), cotton owlet moth (corn earworm, Chloridea obsoluta), fruit eater ("plodozhorka") smut beetle (Phalacrus politus), apple scab (Venturia inoequalis), and against other important pests and diseases of agricultural crops.

Neither is everything satisfactory in the line of biological method of control. Thus, for instance, the mass application of trichogramma has begun already a few years ago. In connection with this, it seems, the problem of effectiveness should have been well clarified. Meanwhile, after a few years of mass application and of yearly hot debates, in 1939 the application of trichogramma against fruit-eater ("plodozhorka") has been almost abandoned. Discussions still continue as to the doses and the time of freeing of trichogramma and of its effectiveness against other pests (winter owlet moth, corn earworm and others); a question arose about the softening influence of the methods practiced in breeding and of race specialization of the trichogramma, as to the justification of its unstable and low effectiveness; along with it the indisputable and objective method for determination of its very effectiveness, for instance, against winter owlet moth, meadow moth and others is factually lacking. Such a

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situation appeared to be possible only because, at the request of the operating organizations, the application of trichogramma, based (as in the case of measures against the sugar-beet weevil) on occasionally good or only seemingly good results, which were obtained empirically, outstripped the thorough study of the very trichogramma and the insect hosts against whom it was directed, as well. Unfortunately, it is necessary to ascertain that the mistakes admitted in the case of the trichogramma are repeated at the present time in working out the problem of the application of Telenomus (Microphanorus Semistriatus Nees) against eurygaster. Not possessing any definite data in economical effectiveness of the Telenomus, and besides, after having determined that under the name of Telenomus there is hidden a whole complex of biologically and ecologically different and entirely unknown species, NKZ USSR (People's Commissariat of Agriculture of USSR) planned the mass breeding and the application of such a Telenomus.

As a result of such primitive ideological tendency the plans of scientific research institutions for plant protection, including VIZR (All-Union Institute for Plant Protection) had until now a very colorful character; the purposefulness and the sufficient perspective was missing, there was not methodological nor methodical unity.

The solution of the problem of plant protection has been tried out by many various measures which seemed most appropriate. At the same time the most elementary means, including the thorough study of the subject, were avoided and ignored. The main emphasis was placed on one specific agricultural plant and this attitude did not permit a thorough study of the subject, as it was considered a too lengthy measure and quite indefinite as to the final results.

The given examples with the sugar beet weevil and with the trichogramma indicate exactly that the problems of a thorough study can not be avoided and the

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fastest and the most effective way is to begin a detailed investigation starting from these very problems.

The existing situation is intolerable and a further development of the matter of plant protection, according to the decisions of 18th Congress of VKP (b) on crop increase) has to be based on the most radical decisions of the problem of checking the most aggressive pests and diseases of agricultural plants by man's intervention into the historically formed structure of agro-biocenosis which we have at the present time. The most destroying methods of control would not be able to fulfill this problem, since they are all only palliative measures which produce only a temporary effect and which demand a constant repetition according to the periodical appearance of the pest and of disease.

As the basis for such an intervention will be the Darwinistic materialistic understanding and a corresponding study not only of the direct relationship of the parasite to the plant, but also of the whole complicated complex of biocenotic relationships in time and in space (antagonistic and mutual assistance, neut neutral and competitive, internal and external) between the host and the parasite, the parasite and its enemies, between the pests, their parasites, super-parasites which give refuge to plant and the environment, which change independently from or depending on man. Out of these relationships any one, by using it correctly, can become the lever by means of which the radical solution of the problem of eradication of a certain pest could be achieved. But for this purpose, a concrete and a thorough knowledge of these relationships, a knowledge which would ensure and indicate the direction of active and deliberate changes in the direction of their weakening and intensification, is necessary.

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In this connection the problem of reproducing agro-biocenosis could be determined by the following means, which, although having already a place in practice and in the program of research works in plant protection, appeared to be intermittent and did not occupy the corresponding position, even in the main Institute of the Academy of Agricultural Sciences - VIZR.

The First Course is the transformation of the plants, which can be accomplished through selective work, which could go along the line of educating the plant, and on the line of selection of types and varieties which are resistant towards some pests and diseases. In the work of science in plant protection there are several cases of splendid solutions of the problem of checking the most important pests of agriculture, (for instance, sunflowers which are of less resistance, linen which is rust-resistant). But such cases are unique, unfortunately, however, not as result of extraordinary difficulties, aroused in the process of cultivation of similar varieties, but because such a problem did not seem to be obligatory nor important within the program of our exploring institutions. Furthermore, only two years ago selective institutions did not consider it necessary to give the evaluation of the action of some of the newly invented measures on the pests and diseases. On the other hand, there are great quantities of pests and especially some plant diseases which are the scourge of agricultural crops (grain flies, rusting of grains, smut etc.) and which nevertheless remained up to date entirely invulnerable or which require huge and expensive measures for their destruction. Against such pests the method of resistant varieties appears to be almost the only possible and the most expedient method of control providing at the same time the widest field for research.

As basic problems in this line of the exploring institutions in plant protection which are already being solved in the laboratories of specialization in

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parasites VIZR (supervisor - T. I. Fedotova) should be: the working out and the elucidation of the principle of immunity of separate varieties of agricultural plants to certain pests and diseases and to the complex of the same, the study of change of immunity in separate species and varieties of plants according to external conditions based on that - the working out of a methodology to determine the immune varieties for selectors.

Second Course - the introduction into the composition of the fauna and micoflora of entirely new components - of parasites and of destroyers from other natural districts or the strengthening of the role of local parasites and destroyers by means of selection and of providing favorable conditions for them. The outlook for this direction has been already (demonstrated?) in our Union (the Laboratory of Biological Method VIZR, supervisor - N. F. Meier) by vivid examples of full and extremely rapid eradication of two very dangerous pests of fruit crops, which removed the necessity of other measures: 1) bloody aphids ("tli") [woody apple aphid, Eriosom langerum] on the apple tree, in the South of USSR by means of acclimatising its parasite Aphelinus which was imported from abroad in 1930; 2) of fluted coccodea, cotton cushion scale, Icerya Purchasi, on citrus trees on Caucasian shores - with the assistance of a predatory beetle rodolia which also was imported from abroad in 1931. Unfortunately, the extraordinary success of these experiments taken from American practice did not serve for the necessary and systematic expansion of similar works. In the following years all work in acclimatization in our Union of foreign parasites was limited to very few and essentially occasional objects, the problems being partly unfinished even at the present time and namely: by works on the acclimatization of Australian beetle cryptolemus against flour scale

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insects (Coccidae) and against scale-insect-Pulvinaria, by experiments on the application of of Chilochorus (partly imported, partly local) against the California scale (San Jose scale, Aspidistus (now Quadraspidiotus) perniciosus) and by research on the question of strengthening the role of local parasites - wasp - scolia against may-beetle ("maiskii zhuk") by means of improving the nutritional conditions of their existance in the imago stage (the latter under the supervision of Prof. V. N. Stark). Meanwhile during the very same years, as it is shown by foreign practice, systematic works on acclimatization of predators and of parasites against imported and local pests also were crowned with success. In Australia, England, France, Spain, Mexico, Brazil, and Argentina with the assistance of the ichneumon-fly, Prospaltella berlesi, the problem of checking the Lepidosaphes ulmi of mulberry tree was solved successfully. In the United States, with the assistance of preying birds and parasites which have been systematically imported during a series of years, the catastropical spreading and propagation of the unpaired silkworm (gypsy moth, Porthetria dispar) and of brown tail moth, (Hygmia phaeorrhoea) ceased entirely. At the present time parasites of corn borer moth are imported intensively to the United States and during the year 1935, alone, 19 species of ichneumon-flies were imported and acclimatized. On the islands of Fiji and Hawaii with the assistance of exported Scolia manilae the scourge of sugar-cane, Anomalia orientalis, has been entirely exterminated. The same results were obtained on the islands of Maurtius, Barbados, Madagascar, Porto-Rico and Ridzhir by importation of a whole complex of Scolidae against the pest of sugar cane, Lachnosterna Smithi.

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The reason for the very slight development in our Union of research on the acclimatization of predators and of parasites consists mainly in our infatuation during the last few years with the form of biological method which is more primitive and at the same time less radical and perspective and more cumbersome and more expensive - the application of some parasites (particularly the trichogramma) by means of artificial accumulation and the periodical release in some other areas. In the same direction, unfortunately, until now the microbiological method of checking harmful insects has been worked out.

The shifting of emphasis in the cultivation of the biological method against harmful insects to the problems of acclimatization of predatory insects and of parasites, not characteristic for the given territory, is absolutely imperative and must be accomplished, although it will require a considerable widening and deepening of the theoretical level of work on biological method. Special attention should be given to the searching for parasites and predatory insects in our country.

As another part of the problem of regulation of the composite of agrobiocoenosis is solving the problem of stopping the penetration of new harmful components into the composition of our fauna and microflora, on the basis of comparative study and analysis of natural-economic conditions of the attached territories in our Union and of biocecology of basic quarantine objects on a universal scale which already has been fulfilled with success by the quarantine sector NKZ USSR and its network.

The Third Course - the changing of the very environment (in a narrow sense of the word) of the existence of parasites of agricultural plants. This course at the same time deals with the pest against which the control is carried out, its enemies and the protected plant, thus requiring an all-sided and thorough

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study and ascertainment of the relations between all the basis components of agricultural biocoenosis. As the basic method of control in this case are considered agrotechnical measures which strengthen the influence of the environment upon the pests, and which are unfavorable and have a weakening influence on the opposite environment. One could indicate many examples of the partial solution of the problem of checking the pest and diseases. It is sufficient to mention the optimal time of sowing, timely shallow plowing, and early ploughing in controlling Hessian fly [Mayetiola destructor], and partly controlling rust, the role of black and of tilled fallow and the refinement of fallow prior to sowing in controlling winter owlet moth [Agrotis segetum Schiff], Fall and early Spring ploughing of stubble against the meadow moth [Loxostege sticticalus], the working out of cultivation between rows, etc. There are fewer examples of radical solution and they are less typical since they are essentially indispensable and not intentional results of man's historical activity in connection with his separation and adaptation of new spaces for planting. As such examples might serve: the extermination of some focuses of asiatic locust [migratory locust, Locusta migratoria], in connection with drying and cultivation of low shores and small islands in the deltas of the Don, Dniepr and some other rivers; the curtailment of focuses of separate locusts ("odinochnyi") and of susliks [ground squirrel, Citellus citillus], in connection with ploughing of stepps of virgin soil in the South and in South-West of USSR and others.

In the history of plant protection there is not as yet any case of a successful and full eradication of a pest, which adapted itself to the assimilated territory, guided by the change of its environment. The latter is explained by the following:

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first, that not one of the complexes in agriculture has been applied nor studied, as a result of which the role of the complexes and the minimizing of certain pests has not been worked out, and secondly, the working out of agrotechnical measures of control has been based up to recent times on the passive superficial study of post-factum influence of the technique of the given crop which already existed and which has been worked out without the participation of entomologists and phytopathologists without even considering the possibility of changing in the interests of controlling pests and diseases.

Such a subordinated significance of problems of controlling pests and diseases in general agricultural technique of the crop, which gives them a mere supplementary position to agricultural technique, is apparently abnormal. Agrotechnique and plant protection should have equal rights and responsibilities in the working out of problems of cultivation of any crop on the basis of an obligatory, permanent and closest contact in the process of all research.

Accordingly in the practice of research in plant protection the primitive stating of results and of effects of the application of that or other agricultural procedure in treatment should be replaced by a deep and wide parallel study of the essense of the influence of factors of the external environment, including methods of treatment, on the development and interrelationship between the pest and the plant.

In this respect the experiment of the corresponding study in recent years by VIZ ( ) of sugar-beet weevil [Bothynoderes punctiventus], indicated that against that pest which adapts itself especially easily to the plant of sugar beet all courses in agricultural control have not been exhausted nor foreseen as yet. Thus, it has been stated that by means of some change in the acidity of the soil, by choice of fertilizers harmless for sugar beets, one could

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theoretically stimulate and bring up to 100 o/o the natural dying out of the posterity of the weevil through fungus diseases, limiting in this case the natural complex of conditions which has been observed with some soil types in nature. On the other hand, it has also been determined that by a comparatively insignificant change in the composition of soil air, and namely by depriving it of oxygen for a short while, it would be possible to exterminate in general the weevil ("zhuk") of the sugar beet weevil in the places of their development and hibernation by means of appropriate agrochemical and agrophysical control. These two new planned courses of the radical solution of the problem of controlling the sugar beet weevil are, of course, far from being achieved and will require tremendous further work together with the agrochemists, pedologists and agrotechnicians, but they, seemingly, are quite realistic and interesting as the indicator of possibilities in the problem of controlling on the pest at the corresponding approach to its study by means of the environment.

The development of similar works against the majority of other pests and diseases, that were studied in still lesser degree than weevil, is the third and greatest task in formulating the problem in working out measures in their checking.

The indicated three courses of the radical reconstruction of agrobiocoenose are difficult and will require in many cases great and prolonged explorations for its fulfillment. Therefore, along with the solution of the most important problems indicated above it is absolutely impossible to abandon the measures of direct destruction of pests in places of their greatest gathering, in the first place by means of applying chemical measures of control which are at this stage of development and will remain for the next few years as the leading measures, and then by means of their physical, mechanical destruction and by the biological in a more narrow sense of the word, by means of inundation by a "living insecticide." This is the fourth and equally valuable course of the solution of the

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problem of protection of agricultural plants. But even in this case the course of research should be changed in the direction of theoretically intelligent wide and deep study of the essence and regularity of control of certain chemical or physical agents upon the very pest itself and the protected plant as well, applicable to the concrete conditions of development and of the behavior of the latter, having as aim the increase of effectiveness of measures, the simplification and the cheapening of the same.

As a rule, this almost hardly has been done before and only by that could one explain the fact that even the chemical method of control, as it has been indicated above on the example of the weevil, which is basic in the group of methods of direct destruction of pests and of diseases, in spite of the duration of its existence and of the extent of its development, does not have up to now the necessary theoretical foundation. In particular along the chemical method the following are insufficiently worked out: the theoretical problems of separate groups of the insecticides and fungicides themselves and the methods of their application; the mechanism of the influence of poisons upon the insects and the organisms on the protected plant; physico-chemical, physical and mechanical foundations in theapplication of the poisons. The application of insecticides and fungicides against certain pests, as a rule, is based on an occasional experiment, without sufficient ecological foundation, without consideration of specific nature of the pest - of the living insect, the living instigator of the disease, which did not remain passive to the action of the poison and to the form of technique of its application, because the final result of chemical control is the result of the interrelationship of the poison and of the living organism, and not a simple reaction of the poison upon the organism.

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The stating of the mechanism of the control will be the basis for the correct scientifically based selection of poisons and will indicate courses for establishing and for producing new poisons, more toxic than the ones now applied, will indicate courses of placing of chemical means, of selection and refinement of the doses, in connection with various conditions of environment, various ages and the behavior of the pest and of the parasite.

The investigation of physico-chemical and of physical qualities of the applied compound as against the interrelationship between the applied compound and the machine, between the compound and the environment (including the protected plant) will give a stable basis for the establishment of the physical form of the poison and for the construction of the machine as well. Special attention has to be given to the complex mechanism, which has been specified by the decisions of the 18th Congress of VKP(b).

Along the line of physical and mechanical methods of checking (light, heat, electricity etc.) almost no research was done in connection with which the development of scientific methods in this group is also the very next and the very important task.

But it would be absolutely wrong and harmful to build up the work in the field of plant protection merely in relation to control on the crops themselves, cutting off the problems of conservation of storage, where the pests do as much damage as in the fields. Therefore the problems of working out methods of grain conservation in storage places should be established in the program of research institutions for plant protection along with the methods which are worked out for the conservation of crops during the growth of the plants.

Such are the four basic, equally valuable courses in the working out of problems in the control of pests and diseases of agricultural crops. From our

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point of view only they could raise the matter of plant protection to a new higher level and assist in a short term in the general task planned by the party and by the government - to give the land an abundance of agricultural products, to eradicate losses and damages caused by pests and diseases. By the old methods, as the past stage in plant protection has indicated, this task could not have been fulfilled.

In accordance with the planned ideological rearmament and shifting of the emphasis in research work in plant protection to different points the solution of the problem of controlling certain pests should go from the point of view of organization and methodology along the line of simultaneous searching for means of control in all the four directions indicated above by means of thorough revision of existing measures on the basis of a wide and deep study of productive conditions of ecology and biology of pests in connection with the entire sum of natural economic factors.

On the other hand it is evident that the unavoidable widening and deepening of the theoretical basis of investigating work in plant protection along new lines could not be ensured by the power of workers in plant protection only, and will require the immediate bringing into research of the related departments ((agrotechnicians, agrochemists, agrophysicists, plant growers and others). The latter task could be solved either by means of creating in the research institutions in plant protection subdepartments of related specialties, or by means of organizing complex interinstitutional research which will appear for us more expedient.

In accordance with the above exposition the structure of institutions in plant protection will have to undergo some changes, including also VIZR, in the

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direction of establishing laboratories and groups in the methods of control in replacing the existing methods against the systematic and economic groups of pests and diseases, and should embrace all the basic natural-economic regions of the land.

At the same time the program of works of the main Institute for Plant Protection - VIZR - should be limited to a few most important and typical pests and diseases of agricultural plants, so that the working out of measures in controlling the same could serve as the methodical example for the branch and territorial network of research institutions in plant protection.

April 26, 1951

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Antipova, L. K.
Resistance of potatoes to Epilachna
Sad i Ogorod, Aug., 1950 (8): 34-36. 80 Sal3

Translated from the Russian by
S. N. Monson.

The potato pest Epilachna, the 28-dotted ladybug (Epilachna vigintioctomaculata Mtsch.) is spread in the Far East. Injuries caused by the parasite reach high proportions. In forest regions epilachna may damage up to 100 percent of potato plants in the fields. On plots distant from forests it may cause injury to 25 to 40 percent of plants.

As a potato pest Epilachna has been observed in the regions of the Primorie territory - Vladivostok, Kalinin, Molotov, Pos'etsk, Spassk, Khorol, Shkotov, Shmakov. Beetles and larva of epilachna feed chiefly on plants of the Solanaceae family (potatoes, tomatoes, physalis, pepper, tobacco, eggplant, black nightshade), and Cucurbitae (cucumbers and squash).

Injuries caused to potatoes by epilachna resemble those of the Colorado beetle. Aside from leaves, the beetles injure flowers of potatoes, squash and the envelopes of the physalis fruits. Among selected potato varieties there are none resistant to injuries caused by epilachna and the Colorado beetle. It is known, nevertheless, that plants of some wild potato species and their hybrids are resistant to the Colorado beetle. Resistance is connected with the content of alkaloids in those plants. According to literary data, the wild species of the group Commersoniana S. commersonii, S. chacoinse, S. millanii, S. parodii, and among other groups, the Mexican S. Jamesii, S. polyadenium, S. demissum are resistant to the Colorado beetle.

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It is further known that the resistance of potatoes to injuries from insects is complex and some authorities (S. M. Bukasov, for instance) believe that resistance of potato species to epilachna equals that to the Colorado beetle.

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Resistance of potatoes to epilachna has not been studied up to now.

In 1949 the Far Eastern Experiment Station of the All-Union Institute of Plant Industry (Vladivostok region of the Primorie Territory), where epilachna is widespread, planted a collection of wild species of potatoes, of complex intra-species hybrids and selected varieties. Seeds of wild species and intra-species hybrids were also planted. In addition, regular observations were conducted and the degrees of injuries of potatoes by epilachna established on seed growing plots of potatoes at the station (on plot of 3 hectares and on the varieties Siekingen and Arran Pilot) and at collective farms of the Khorol region, imeni Stalina and Molotova. The collection of selected varieties and intra-species hybrids was planted during spring and summer periods.

Beetles winter in the forest under the fallen leaves of the previous year, under stones, in soil crevices, etc. The flight of beetles begins usually in the second and latter part of May when the average daily temperature is established at 9 to 12°. Upon leaving their wintering abodes the beetles begin to mate. The females differ from the males in larger size and the rounder shapes of their bodies. In 1949 the first egg laying began on June 14, and lasted until August 6; thus it was possible to observe simultaneously mating, egg laying and larva in their different stages. One female lays from 200 to 500 eggs (average 350) primarily upon the under surface of leaves appearing as vertically glued eggs to the leaf. The lower leaves are evidently preferred for the development of eggs since it is there that the groups are largest. Eggs are primarily laid on potato plants although they were also observed on other plants, such as tomatoes, pigweed and burdock. The first larva hold on to the under surface of leaves and then spread along the remaining part of the plant, transferring

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from weeds to potatoes. The larva loses its color three times in the course of its development, i.e. it has 4 ages which last about 5 to 6 days each. In 1949 the beetles of the new generation appeared on August 3. In the Primorie epilachna produces one generation. During the various hours of the day the number of adult beetles on different plants of wild potato species varied from 5 to 20 pieces.

Species where the percentage of injury on the leaf surface of plants did not exceed 10 to 20 were considered resistant to epilachna. Into this group belonged: S. rionegrirum, S. laplaticum, S. demissum, S. xitlense, S. demissum v. orientale, S. demissum tlaxpehaulcoense, S. Garciae, S. Schickii. Another group of wild species proved different in its resistance to epilachna, i.e. various specimens of plants of the same species were injured from 5 to 10 percent up to 50 percent. Insignificant injuries among many plants of this group of wild species may be explained by their built, general habit, the distribution of leaves (usually sparse) and their pubescence. Egg laying occurred seldom and in spots on plants of sparse leaf distribution and in those where the leaves stood vertically above the soil surface, while on individual clusters of selected potato varieties the number of egg layings reached 10 to 30, in some cases 70. Plants of the group of wild species were injured from 5 to 10 percent. Thus 6 specimens of the species S. leptostigma were injured 10 percent, 4 specimens of S. catarthrum 10 percent, 3 specimens of S. molinae 10 percent, 9 specimens of S. gibberulosum 10 percent, 5 specimens of S. horovitzii 10 percent, 4 specimens of S. antipovitzii v. Gandarae 10 percent.

Other specimens of the same species were injured considerably more.

The different degree in injury by epilachna of plants of the same species

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is explained by the changeability of potato seedlings.

Specimens of other wild potato species from the same collection were injured 50 to 70 percent, i.e., in equal measure with selected varieties.

Plants of the collection of primitive potato species and the Chilean specimens of the species S. tuberosum are affected by epilachna in the same degree as selected varieties, i.e., 50 - 80 percent, in individual cases 90 to 100 percent.

The group of late varieties stood out in rapid renewed growth of foliage following injuries; i.e., Wohltman, Pegina, Siekingen, Condor, and some others. Early varieties took longer in growing new foliage, and so did the varieties Framm, Peachblow, Weltwunder, and several others.

Complex intra-species hybrids (S. demissum participated in the crossings as a phytophthora-resistant variety and also as resistant to the Colorado beetle, and different varieties of S. tuberosum, as carriers of economically valuable characteristics proved susceptible to epilachna in various measure. A series of hybrids was selected which were injured 10 to 15 percent and up to 30 - 40 percent, and still possessed the ability to rapidly reproduce their foliage. Some of these hybrids proved of high yield.

The experiments provided the opportunity to establish that among wild potato species there are specimens resistant to injuries by epilachna.

Complex intra-species hybrids with S. demissum possess varied degrees of resistance to epilachna and some of these are distinguished by a low degree of susceptibility. The resistance of potato species to epilachna and the Colorado beetle coincides, at least within the group of species tested in the collection.

End of article.

3/8/51

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Arnautov, V. V. (Laureate of Stalin premium)
Potato Degeneration in the South and
Measures for Control
Sad i Ogorod 1949(5):72-73. May 1949. 80 Sa 13

R-28

Translated from the Russian by
S. N. Monson

Potato wilt has reached a wide distribution and causes substantial losses in potato yields in a series of southern territories, oblasts and republics. Many researchers have for over ten years been engaged in studying the nature of potato wilt and the causes prompting it. The real reasons for producing this disease remain unknown as yet, nor have effective means to combat it been discovered.

Upon an analysis and study of the material of different researchers who describe the characteristics, the course of the disease and the conditions under which it appears and progresses, I have come to the following conclusion: the primary cause of potato wilt in the south is the stifling of the root system of the plant produced by an inordinately heavy soil, caked after rainfall and watering, which prevents the air from reaching the root system. Plants of which the root system have been stifled continue to preserve a normal appearance for a while and their metabolism, though in weaker form, is continued at the expense of elements of nutrition and moisture which are obtained from the surviving upper rootlets.

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Brief spells of precipitation followed by clear, sunny and hot weather are damaging to such plants.

In absorbing rain moisture from the surface of their leaves the plants sharply accelerate their life activity, the process of breathing is speeded up and with the arrival of a sunny day evaporation is increased. The weak upper root system is not able to compensate for the loss of moisture in the soil, the

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normal exchange comes to a radical stop and leads to the final catastrophe, the destruction of the plant.

The stifled root system offers a favorable environment for bacterial fungous parasites (fusarium, verticillum, etc.) which penetrate into the vascular system and increase the decay of the plant. This accounts for the wrong impression obtained by many researchers concerning the original cause of the disease.

In my opinion, an effective measure of controlling potato wilt in the south in summer plantings will be the planting of potatoes on well prepared soil (plowed in the fall) and the continued preservation of its upper layer in a friable condition to a depth of 6-8 cm.

Harrowing of the field prior to sprouting and at the time of the appearance of sprouts is necessary to accomplish this; deep cultivation between the rows with horse-driven web-footed equipment (?) done no less than 5-6 times; within the rows hand hoeing, beginning from the time of sprouting to the period of full bloom.

This cultivating should be done after every rainfall and watering, especially on inundated soils with caked surface in an effort to prevent by every means the hardening of the soil in the area of the root system and the formation of crust even for a brief period of time.

End of article

Ed. remark: Considering that there prevail diverse viewpoints with regard to causes of potato wilt in the south, the editor requests scientific workers engaged in potato studies to engage in experiments to verify the conclusions presented by the laureate of the Stalin premium, V. V. Arnautov.

2-27-51

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Bondarzev-Monseverde, V. N.
About Rhizoctonia solani Kühn on Potatoes in Connection with Modern Methods of Cultivation. Akademiia Nauk. Botanicheskii Institut. Sbornik nauchnykh rabot (1941-1943), p. 393-395. Leningrad, 1946. 451.1 Ak12

A29

Translated from the Russian by
S. N. Monson

The present work represents the result of preliminary experiments made to solve the problem of the significance of rhizoctonia for the culture of potatoes under Leningrad conditions, particularly for an accelerated method of their propagation. It was regrettable that it was necessary to utilize for experiments only ("obezlichennii") unrepresentative potatoes infected by rhizoctonia. One part of the tubers was vernalized for three weeks. Their weight varied between 20-25 g. The soil of plots was unfertilized, a light sandy loam from under clover, slightly alkalic; additional feeding of ashes was provided once and twice of super-phosphate. In one series 18 tops or 12 tubers were planted on each plot; in another series the young plants were planted in groups of 24 plants. The tops were taken from state farms from plants prepared in the winter. Inspection was made by digging under the young plants grown from tubers and tops every 24-25 days following the planting and in each case the degree of infection on each plant was noted. The yield was gathered between September 15-18. The results of the first series of experiments are presented in Table 1.

They show that at a reduced planting depth of tubers a lighter degree of rhizoctonia was observed. The slightly smaller yield of potatoes, planted at a depth of 6 cm., in spite of the reduction of the percentage of infection, is explained by the circumstances of the particular experiment, since in a soil that dries out easily unfavorable conditions are created for potato growing.

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A later date of planting resulted in a reduced percentage of disease and a slight increase in yield, the rest of conditions remaining the same, irrespective

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of whether the plantings were of whole tubers or only tops. The negative influence exerted by rhizoctonia upon the yield of tubers showed on 5-6 plots an average yield of 386 g. from each infected clump and 423 g. from the control).

As to vernalization, judging from the above experiments, it did not produce any positive effect upon lowering the degree of infection.

The table further indicates that the tops produced a significant loss, as had been also the case at the state farms from which they were obtained. Of particular interest was the lack of sclerotia of rhizoctonia obtained from infected material on tubers in the vast majority of cases.

Table 1

INFECTION OF POTATOES WITH RHIZOCTONIA UNDER VARIOUS CONDITIONS OF PLANTING

No. of plots	Depth of planting (in cm.)	Time of planting	Whether vernalization was applied	No. of infected plants in sprouting stage (%)				Uninfected plants	Loss from fusarium and bacteriosis (%)	Average yield from 1 clump (in kgt.)
				Severe Infection	Moderate infection	Light infection	Total			
In planting with tubers										
1	12	May 9	Yes	56	11	22	89	11	-	362
2	6	May 9	"	12	10	34	56	44	-	318
3	12	May 20	"	51	16	9	76	24	-	446
4	6	May 20	"	14	15	11	40	60	-	405
5	10	May 9	No	28	9	10	47	53	-	386
6	10	May 9	"					100	-	423
In planting with tops (CONTROL)										
7	10	May 20	No	16	20	29	65	9	26	390
8	5	May 20	No	11	3	38	52	19	19	348

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Remarks: 1. The degree of infection of plants was determined visually. Sprouts were considered severely infected when decayed under the influence of rhizoctonia or when they carried deep ulcers; moderately infected when ulcerated or having brown large spots; lightly infected when having brown stripes and light degree of discoloration.

2. The yield from those plants was also included into the average weight of yield from the plot which at first examination did not show diseased plants, while in harvesting a significant part of these plants carried the traces of infection by rhizoctonia on roots and stolons. As to several clumps which subsequently showed black leg and wilt, these were not taken into consideration in the estimate of the average yield.

SCLEROTIA WERE OBSERVED only on the third (4 clumps) and fourth (3 clumps) of the plots. The appearance of the disease on mature plants, aside from tubers, was limited to more or less clearly pronounced brown spots and stripes on stolons and roots, which changed occasionally into superficial ulcerations. These injuries, it was noted, could have been the result of the formation of small tubers. The weak manifestation of rhizoctonia on tubers should be ascribed to the unfavorable soil conditions for the fungus, primarily low moisture, since the remainder of the same seed material capable of suberizing planted on a still lower plot of podzol, clayey soils, produced many infected tubers, in some cases with unusually developed sclerotia in the shape of large knots. A complete absence of sclerotia on tubers was noted on plots where the influence of the soil was being tested after artificial inoculation by the culture of the fungus and introduction in planting under healthy tubers and tops.

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The dryness of the soil may account for the unusually light development of the basidial stage of this fungus on experimental plots (Corticium solani Pril. et Del). This stage was observed at the end of the first ten days of August in the amount of only 3-4 per cent.

Let us observe the results of our observations of the young plants. On June 2 the plants in various degrees of infection of rootlets and stems, chiefly in their lower parts, obtained from non-varietal potatoes, were selected and planted. There were altogether four plots of infected material and one control plot:

1. Plot of young plants lightly infected produced an average yield of 112 g per clump.
2. Plot of plants mf more heavily infected, but without injury caused to growing point of the stem; average yield 105 g. per clump;
3. Plot of plants where growing point was infected and side runners were consequently formed; average yield 91 g. per clump.
4. Plot of plants without exterior signs of infection, where soil inoculated with pure culture of rhizoctonia had been introduced under the roots in planting; average yield 98 g per clump;
5. Control plot: average yield 136 g per clump.

In the beginning the growth was delayed, it fell behind that of the control. Later the outward appearance of the young plants did not differ from the control. Sclerotia on tubers were lacking; the infection of underground parts was similar to that which was observed on plots planted with infected tubers, with the exception that here a severe browning of the foundation of the stem was observed more frequently.

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The results of our experiments lead us to the following conclusions, although in some cases they require further application.

1. The principal damage by rhizoctonia shows in the infection of sprouts.

2. Tubers with sclerotia of rhizoctonia develop infected sprouts; the degree of their infection depends upon a complex of a variety of factors (temperature and moisture of the soil, its composition, varietal characteristics of the plant, etc.)

3. The date of the planting reacts upon the degree and severity of the infection of sprouts. At an early planting (May 9), the per cent of infected sprouts was larger in connection with the lower temperature which delayed their growth.

4. A more sidely spaced ("melkaia") planting of tubers and tops reacted favorably upon lowering the number of infected sprouts, but on light dry soils it led to a lowering of the yield, and may thus be used only on sufficiently moist and consequently heavier soils.

5. The potato sprouts with infected rootlets and stems produced in our experiments a lower yield, but towards the end of the vegetative period there was no apparent distinction between the control and the tested plantings.

6. The basidial stage of the fungus was observed on individual specimens and did not correspond to the number of plants with infected sprouts.

7. Sclerotia on tubers obtained from diseased material were observed only on individual clumps on two plots.

End of article

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Declassified and Approved For Release 2013/03/25 : CIA-RDP80R01426R009900010001-5

Bordukova, M. B. System of prophylactic measures in the control of Phytophthora. Sad i Ogorod 1947 (7): 25-30. July 1947.

Translated from the Russian by
S. N. Monson

A considerable part of the grown and gathered potato yield is lost as a result of different diseases. In order to appraise these losses it is sufficient to state that 10-15 percent of the loss is caused by phytophthora alone. An amount ample to supply the entire network of Soviet distilling plants for the period of one year.

Phytophthora is particularly spread in locations having a humid climate, such as the Belorussian SSR, the Leningrad oblast, Western and Eastern Siberia, and other localities. Here the loss in potato yield reaches in separate years some 50-70 percent. Especially affected are plantings of the varieties Early rose, Courier, Berlichingen, Sovietski, etc.

The tuber affected by phytophthora is very hard upon touch; brown, indented spots are seen on the surface; the pulp of a diseased tuber is also brown. The phytophthora spot on potato leaves frequently appears at the end of the leaf blade or on its side (the drop of dew keeps longer here than anywhere else.) The spot is moist, of dark-brown color. In the early morning, when there is dew, a white, friable pubescence (down), consisting of the conidia of the fungus, is seen on the lower surface of the leaf.

The tubers of the new harvest are infected during growth (at the time the conidia are washed off from diseased plants by the rain and

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penetrate into the soil along with the water) and through contact with diseased leaves during harvesting. In the first instance the tubers frequently rot in the soil, in the second - the infection is carried to the surface. Subsequently, the conidia which are on the surface of tubers, may perish if conditions are unfavorable to their growth or, on the contrary, they may develop if moisture is present and the temperature adequate, the tuber then getting infected after the harvest. Practice has shown that potatoes perish from phytophthora not alone in the soil prior to harvesting, as much as in the first months of winter storing. The phytophthora fungus is capable of penetrating very rapidly into the plant tissues. It has been established that at 100 percent relative humidity and a temperature of 17-18° the conidia are capable of growing in the first 40 minutes (after being carried onto the tubers) and in the following 5 to 7 hours penetrate into the plant tissue or leaf. Ten days are enough to produce rotting of the tuber, leafs rotting in 4-5 days.

In the fall the tubers are gathered from the soil in a moist state during harvesting; frequently they are loaded directly from the fields for permanent storing; the temperature and relative humidity in storage are at times high. The potatoes are for a prolonged period in an enviroment favorable to the development of fungi. Once the fungi penetrate the tissues of the tuber, applying measures for controlling the disease is superfluous. Neither drying nor treatment with a mordant are able to stop the future development of the disease.

To prevent damage of the potato by phytophthora a system of measures has to be maintained.

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This system consists in the following. Only healthy potatoes are selected for sowing. Diseased tubers, if planted, produce late and diseased seedlings which appear on the 45-60 day after planting. By that time the plant of a healthy potato possesses already a powerful leafage. Conidia form on the late and diseased seedlings under the shadow of this plant and in instances of rains in the late summer, or dew and fogs, the infection of the healthy plant takes place. Consequently, the fewer diseased tubers (with hardly noticeable traits of disease) get into the sowing material, the fewer will be the nidi of disease on potato sowings.

The vernalizing of early varieties to control phytophthora is of enormous significance. The earlier an early potato ripens the greater the chances that it will not be affected by phytophthora. In the climatic conditions of the central belt phytophthora will appear in the beginning of August, and by the middle of August the vernalized potato will already be ripe and if gathered in time from the field the harvest may by this very measure be completely saved from loss (damage). In addition, vernalization aids in the manifestation of all diseases (including phytophthora) found in a tuber in a hidden state during winter storage. The temperature of 15-17° aids the development of diseases and all tubers rotted during the period of vernalization should be removed.

The application of preventive measures in the spring only does not ensure full success in controlling phytophthora, since one should not overlook that this disease may be transmitted also through an infected soil

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where the fungi winter in the form of dormant spores. The life duration of these spores in the soil has not been established. Indirectly, we may assume that winter spores are sufficiently long-lived because in many regions phytophthora appears in intervals of from 5 to 7 years. Whenever, the first spots of the disease appear on the leaves it is necessary to immediately dust the leaves of potatoes on seed plots with the preparation AB in the proportion of 20-35 kg per hectare. One may apply the poison from small gauze bags by sprinkling, if special sprayers are lacking. An excellent reaction is produced by using a 1 percent Bordeaux mixture (400-600.l per hectare), which consists of a mixture of copper sulfate with unslaked limed. Bordeaux mixture represents not only a good fungicide but it also simultaneously exerts a stimulating action upon the amount of the yield.

The cutting of leaves was usually recommended for controlling phytophthora. This process is, however, labor consuming, aside from being also less effective. The ineffectiveness of cutting leaves is confirmed by the data presented in the table published below:

TABLE I

***

Variations of Experiments	Degree of Infection of leaves	Percent of diseased tubers at harvest	Percent of diseased tubers after 1 mo. and 20 days
Leaves not cut (control)..	100	13.3	33.3
Leaves cut 15 days prior to harvest	100	12.0	21.3

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leaves cut 10 days prior to harvest; soil sprinkled with 1 percent copper sulfate	100	9.3	19.0

The staff members Yatsynina and Rozhdestvenski of the Institute of Potato Industry indicate that during late cutting the potatoes are rotting anyway because of phytophthora and that at an early cutting there is a shortage of some 13.7 percent in yield, which amount exceeds the losses from phytophthora. One may avoid transmission of diseases from leaves to tubers in other ways. A second hilling aids an increase of the yield and by extending the layer of the soil which divides the infected leaves from the tubers reduces the number of diseased tubers.

The second and most effective method of controlling phytophthora is the drying of tubers. In this instance the considerable sensitivity of the phytophthora fungus to dryness is taken advantage of. At 18-19° of heat and 40 percent of comparative (relative humidity) moisture of the air conidia perish within an hour. The drying should take place immediately following harvesting.

One frequently hears practical agronomists claim that even dried potatoes also rot as a result of phytophthora. Such statement is true to a certain extent since one is used to accept under the term "drying" any kind of drying process which may last from one day in the field in dry and sunny weather to 7 to 10 days when potatoes are heaped in a pile indoors. Rapid drying is achieved in several ways. In dry, sunny weather the tubers are

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placed in thin layers directly in the field. Under the influence of sun rays potatoes dry quickly and the conidia perish. In cold and damp weather one may store potatoes in temporary mounds located directly in the fields. Of decisive importance in this case is a low temperature in which the conidia which settle on the surface of the tubers are incapable of growing; the potatoes placed in mounds have therefore a chance to dry out in 4 - 5 - 6 days. Such tubers after careful sorting store perfectly. This method is frequently used in Siberia. Fair results have been obtained at the Institute of Potato Industry in 1945 in placing diseased potatoes in mounds at a time when the harvesting took place, in extremely trying conditions of a cold fall with early frosts. The mounds should not be covered with leaves since the latter preserve infection even after frosts.

In many oblasts warm weather with scattered, fine rains prevails during harvesting. In those conditions it is difficult to protect potatoes from phytophthora. The only solution in those cases is a rapid artificial drying of the potato tubers in grain dryers and special potato drying machines. The temperature of these drying machines should be maintained at 25-30°. Four hours after drying in such equipment, the potato tubers are entirely freed of the parasite.

Numerous experiments in drying potatoes have invariably produced positive results.

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TABLE II

Number of tubers under experiment	Percent of diseased tubers from phytophthora if dried after infection in:					
	Immediately	in 3 hrs	5 hrs	8 hrs	15 hrs	24 hrs
10	0	0	0	60	80	100
50	0	0	2.5	73	98	100
50	0	0	0	68	87	100
50	0	0	1.0	62	95	100
Total 160	0	0	0.9	65.7	90	100

In performing the latter test the tubers of the variety Early Rose were infected deliberately and artificially, an amount of infection being applied which was intended to result in their being infected 100 percent.

Table II indicates that drying is useful if done within the first 5 hours following infection.

A wider experiment was conducted with naturally infected material. In each group there were 700 tubers. Altogether the experiment involved 4.900 tubers of the variety Courier infected under field conditions 13.5 percent (Table 3).

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TABLE III

The intervals between digging & drying	Number of tubers	Duration of drying at 20-25°	Percent of diseased tubers
Immediately following digging	700	4 hours	17.5
After 3 hours	700	4 hours	25.3
After 5 hours	700	4 hours	27.9
After 8 hours	700	4 hours	30.9
After 15 hours	700	4 hours	32.3
After 24 hours	700	4 hours	46.8
Immediately after digging	700	kept 15 days in a garage	43.5

Depending upon the length of drying there is a radical change in the percentage of diseased tubers in subsequent storing in spite of the fact that the percentage of diseased tubers was the same (13.5 percent) at the beginning of the experiment. In another experiment 4,900 tubers were again selected, this time all apparently healthy, without spots. There were 7 groups in this experiment, of 700 tubers in each (Table IV).

TABLE IV

Intervals between digging and drying	Duration of drying at 20-25°	Percent of diseased tubers infected by phytophthora
Immediately after digging	4 hours	3.2
After 3 hours	4 hours	5.7
After 5 hours	4 hours	6.1

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After 8 hours	4 hours	8.9
After 15 hours	4 hours	9.0
After 24 hours	4 hours	9.0
Immediately after digging	kept 15 days in garage at temp. of 6-10°	27.6

The tubers of the first 6 groups were dried with the aid of a venetilator; the tubers of the 7th group were kept in a garage at a 90-95 percent relative humidity comparative moisture of the air and a temperature of 6-10° C. Fifteen days were required to dry the potatoes in the garage. In that time the fungi managed to penetrate into the tubers, which explains the high percentage in loss (27.6 percent).

The most accessible and effective means of controlling phytophthora is by rapid drying. If collective farms would be in a position to construct special drying equipment for potatoes they would save yearly hundreds of tons in yields and would in the first year repay for the entire cost of the equipment. Rapid and proper drying of potatoes is essential not only in controlling phytophthora but in equally controlling all potato diseases, such as ring rot, black leg, dry rot, etc. Treatment by mordants is similarly effective if done soon after digging. The experiments performed at the Experimental station at Glenheim (England) indicated that one may almost completely eliminate losses from phytophthora provided the seed material is dipped (submerged) immediately after harvesting into a 1 percent

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solution of formaldehyde or in a neutral mixture of copper sulfate and caustic soda (approx. 1 part of caustic soda to 40 parts of a solution of copper sulfate).

Experiments showed that tubers thus treated grew well. The technique of conducting this work is very simple.

Our experiments in studying the effectiveness of treatment by mordants also produced positive results. (Table 5 - p. 11).

So far we are unable to recommend mordant treatment for production purposes since this method has not been sufficiently studied but it would be desirable to test the action of this treatment at collective and state farms in experiments run on a small scale. One hundred liters of solution may be obtained from one kilogram of copper sulfate, an amount adequate for treating one ton of potatoes.

The Department of Plant Protection of the Institute of Potato Industry frequently receives inquiries from locations concerning the fungicidal qualities of the powder AB as a mordant for treating different diseases of seed potatoes. We tested the reaction of this preparation as far back as 1939 and obtained 80 percent of diseased tubers. Aside from that, the treatment delayed the growing of the plants an average of 2-4 days. We have therefore no reason for recommending the preparation AB as a mordant for controlling phytophthora in seed potatoes.

The best results were obtained from 4 percent of copper sulfate and formalin. These poisons did not react unfavorably upon the growth of tubers.

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TABLE V

Mordant	Percent of diseased tubers after 2 months treatment												Percent of diseased tubers in non-treated groups	
	Period of treatment after digging:													
	Immed. after digging		3 hrs		5 hrs		7 hrs		15 hrs		24 hrs			
	ER*	S*	ER	S	ER	S	ER	S	ER	S	ER	S	ER	S
1 percent copper sulfate	0	0	0	0	0	0	0	0	0	0 --	0	2.5	72	100
Formalin 1:200	0	0	0	0	0	0	0	0	3.2	--	9	83.3	100	100
Potassium permanganate $KMnO_4$	17	--	16	--	50	--	59	--	66	--	66	--	100	100
Preparation AB	8	--	8	--	10	--	24	--	59	--	62	--	94	100
Organic copper (A)	0	0	0	0	13	0	42	0	--	12	46	46	100	100
Chloride of lime	0	0	--	--	--	--	-	--	100	100	100	100	100	100

* ER: Early Rose variety
  S: Sovietsky variety

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Extremely sensitive to copper sulfate were the tubers of the variety Lorch, of which the lenticels were burned. The gathered yield is stored only in a healthy state. One considers potatoes healthy after their preliminary "keeping" for 2-1/2 to 3 weeks. During that period all diseases may make their appearance, including that of phytophthora. After this the rotted tubers have to be eliminated and only then may the load of potatoes be transported into storage. The best temperature for storing potatoes is 1-2° C. The variety is also of great significance. The foliage of the varieties Epicure, Epron, Berlichingen get strongly affected by phytophthora, while their tubers remain fairly resistant and are not much affected by the disease.

At present the Scientific-Research Institute of Potato Industry has produced new resistant to phytophthora varieties under the numbers 18883, 12994, etc. The control of phytophthora consists of a complex of measures. Timely application of the above mentioned measures of control will ensure the conservation of grown potatoes. A tentative plan of measures is presented on p. 30.

PREVENTIVE SPRING WORK

In STORAGE	In the Field
Selection of health tubers	Planting to a depth of 14-15 cm
Vernalization	

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Bordukova, M. B.

END OF JULY, BEGINNING OR MIDDLE OF AUGUST
(when first spots of phytophthora appear)

2d hilling

Spraying with 1 percent of Bordeaux mixture

Spraying with AB

Timely harvesting (for early varieties)

END OF AUGUST, FIRST TEN DAYS IN SEPTEMBER
(harvesting of potatoes when leaves are infected)

Timely keeping of tubers for 2-1/3 to 3 wks

Rapid drying of tubers in the sun or in special drying machinery

Spraying with 1 percent of copper sulfate

Timely storing in mounds on fields, under straw cover

STORING OF POTATOES AT A TEMPERATURE OF 1-2° C
Preparation of field for the next year

Disposal of foliage and rotted tubers.

It may be seen that an enormous choice of preventive measures is available for controlling phytophthora. This does not indicate that it is necessary to apply all above mentioned measures. Within each period it is sufficient to apply at least one of the recommended methods in order to reduce yield losses.

End of Article

1/10/51

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Declassified and Approved For Release 2013/03/25 : CIA-RDP80R01426R009900010001-5

Efimov, A. L. Obolenskii, V. N.
and Khizhniak, P. A.
Potato Canker. Selek. i Semen.
14(10):26-30. Oct. 1947. 61.9 Se5

Translated from the Russian by
S. N. Monson

In 1939 there was no potato canker on USSR territory and only in 1940 foci of potato canker were discovered in the Western oblasts of the Ukraine and White Russia (Belorussia). In the succeeding years potato canker was discovered in the Lithuanian SSR and on the Karelian isthmus of Leningrad oblast. In the years of the Great War the system of strictly organized quarantine and other prophylactic measures designed to control the spread of potato canker infection was completely destroyed in the territories under temporary occupation. As a result, the disease spread beyond the boundaries of the original foci.

At present we face in all reality and seriousness the problem of the necessity for the immediate introduction (application) of measures to eliminate the discovered foci of potato canker in the formerly occupied territories, to locate undiscovered foci of infection and eliminate them eventually. The injury caused by potato canker is extremely great. The infection in sections where foci were located amounted to 100 per cent in 1946.

The government correspondingly established compulsory measures for curtailing the spread of potato canker throughout the territory of the USSR. In this connection the export of potatoes from oblasts where canker prevailed was forbidden. The Government Division of Plant Quarantine of the Dept. of Agriculture of the USSR has undertaken essential measures to control the spread of the disease but the danger of it penetrating into other regions is not excluded.

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A number of violations have been discovered in the current year on the part of many preparatory, railroad and other organizations, and individual people who, in spite of government decrees and prevailing quarantine regulations, have been exporting potatoes beyond the borders of the regions and oblasts where potato canker foci are located, thereby spreading the infection.

Between the years of 1939 - 1940 no wide scale scientific-experimental work was conducted in the USSR concerning the study of the potato canker inducer. Beginning 1939, the Central Anti-Canker Laboratory has been in operation which tests all potato varieties and seedlings for canker resistance under laboratory and field conditions, and also searches for methods to control this disease. The laboratory also studies the biological specialization of potato canker and the nature of potato resistance to the disease.

The Central Anti-Canker Laboratory has tested about 3,000 specimens of potatoes for canker resistance under laboratory and field conditions. In laboratory experiments a method is applied which is based on the principle of contacts of fresh canker growth with young potato sprouts. Early canker infection is applied for the infection of young sprouts on cut tops of tubers in moist chambers at a temperature of 12-18°C. in cuvettes filled with moist sand.

In order to create optimal conditions of infection on potato tubers a vaselin ring is laid around the sprout, the center of which is filled with distilled water. On the second day the infected potato tops are dusted with soil mixed with sand and the soil in the cuvettes is maintained at 50-70 per cent of moisture.

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The laboratory experiment is repeated three times and infected varieties non-resistant to canker, along with control (Wohltmann, Early Rose) are grown simultaneously. This method in laboratory experimentation on potato varieties and seedlings for canker resistance has been maintained forffive years under laboratory conditions.

Field experimentation for canker resistance is conducted under natural conditions on plots where canker infection has been evenly introduced.

Simultaneously with the transplanting of potato and seedlings, varieties under test, varieties non-resistant to canker, i. e., Wohltmann, Early, etc., are transplanted for purposes of control.

Under field conditions drought occasionally reduces the frequency of infestation (1946) to such extent that canker growth does not appear at all on varieties known to be susceptible to canker. On the other hand, an abundance of moisture may lead to a premature decay of the growth. It is therefore essential to conduct experiments in the field for two to three years, with the proviso that they be organized under a variety of climatic and soil conditions.

As a result of experiments conducted at the Central Anti-Canker Laboratory only the following varieties proved canker-resistant:

Vekaragis, Imandra, Cobbler, Courier, Majestic, Parnassia, Rosafolia, Jubel, Pepo, Phytophthora-Resistant (8670), Great Scott, Divernon, Siekingen, Berlichingen.

The remaining varieties and seedlings proved non-canker-resistant. They are the varieties: Alma, American-red, Amnister-Frühe, Alma-Ata, Vermont, Varba,

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Valle, Wohltmann, Viola-Vsheznа, Hero, Deodara, Iygeva-Varane, Kronkhi, Kalitinets, Korenev, Carmen, Komsomolets, Krüger, Lorkh, Moskovskii, Narodnii, Petrovskii "Jubilee", Poliarnik, Palliatin, Early Rose, Riasnii, Sovietskii, Stepniak, Stoikii, Stakhanovskii, Smyslovskii, Silesia, Odinets, Umptek, Chippeva, Chervonno-spirtovii, Centifolia, Epron, Epicure, Ella, Shamrock, Schlesien-Klassen, Eschlifim, Ianina, Seedling Reiman.

Seedlings were tested at the following Experiment Stations and Institutes: Voronezh Experiment Station, Institute of Potato Industry; Petrovsk Experiment Station, Ulianovsk Experiment Station, Dotnuvsk Experiment Station, Priekulsk Experiment Station, Belorussian Government Selection Station, All-Union Institute of Plant Industry: SIBNIIZKHOZ; Polar Station of VIR; Gorsk Government Selection Station, Polesak Experiment Station, Ekaterininsk Base Station, Iartsevsk Base Station, Kazan Experiment Station, Leningrad Zonal Station, Institute of Potato Industry. [Omitted are the particular numbers of seedlings, of which there are a great many, tested at the above institutions (p. 28).]

The experiments proved that such basic scientific research institutions as IMKH, VIR, VNIISP, engaged in work on potato selection, have not as yet developed their work on canker-resistant varieties on a necessary scale, despite the growing danger of canker infection.

The situation concerning tests for canker resistance of varieties already regionalized (principal, permissible and potential) for republics, territories and oblasts of the USSR is also far from satisfactory. In examining the lists of 63 regionalized varieties and prospective potato seedlings of 13 republics it was discovered that only 39 had been tested for canker resistance; of these, 31 varieties proved non-canker-resistant.

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Maximum attention has to be devoted to the problem of producing and regionalizing canker-resistant varieties of potatoes since upon this is dependent the fate of the potato industry. This is still more important because it had been considered for many decades that the conduct of canker-resistant potato varieties to their particular canker inducer remains unchanged and that physiological races, the existence of which has been established for an entire series of other pathogenic fungi, are lacking in the case of potato canker.

In 1942, however, a clearly pronounced new biotype of canker inducer was discovered in Giessübel (?), Thuringia, Germany. In order to obtain data on the virulence of the new biotype the entire assortment of canker-resistant varieties, considered suitable for 1941, was in the winter of 1941-1942 submitted to artificial inoculation by the new material. Of 67 tested varieties no less than 58 proved clearly infected, 7 varieties were doubtful, and only on two varieties no sign of infection was observed (Fram and Frühe Hörnchen).

The discovery of the most aggressive biotype of inducer of potato canker (under Thuringia conditions) is of special interest because, according to data provided by the Berlin-Dahlem Biological Institute, this biotype is considerably more aggressive compared to the earlier known Dahlem biotype which served for the evaluation of all known canker-resistant potato varieties until that time.

The Central Anti-Canker Laboratory of the Department of Agriculture of the USSR conducts at present scientific-experimental studies on the biotype of potato canker at different geographical points of the Union. According to preliminary data, 1945-1946, no new biotypes have so far been found, though their presence is quite likely.

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Potato canker endangers our potato industry and it is imperative that measures be taken not to permit the spread of this dangerous disease and on the other hand every effort should be made towards developing such effective methods of controlling the disease as the production of canker-resistant varieties and their wide propagation on fields of collective and state farms, primarily in the Ukraine, Belorussia, Lithuania, Latvia, Esthonia, and the Leningrad oblast.

The task of producing canker-resistant potato varieties is of such timeliness that there should be a prohibition for scientific-research institutions against producing non-canker resistant varieties in republics and oblasts where potato canker is spread and which are endangered by it. Instead, it is essential that these republics and oblasts subordinate their entire potato selection and seed growing work to the fastest possible development of canker-resistant varieties.

One of the principal tasks of selectors in producing new varieties consists in obtaining a variety immune to canker and at the same time resistant to other diseases, as well as possessing high economic qualities.

The Soviet selectors S. M. Bukasov, I. A. Vesselovskii, I. I. Pushkarev and others, consider it fully feasible to produce canker-resistant varieties exclusively. They believe that canker-resistant varieties may easily be produced but that in order to accomplish this selectors should be ensured of the possibility of evaluating produced varieties for canker resistance. The availability of only one anti-canker laboratory in the USSR does not meet this requirement. It is imperative that several new anti-canker laboratories be organized at Leningrad, Minsk (Belorussia), and Lvov (Poland).

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The method of rapid propagation of canker-resistant varieties has been worked out and tested under conditions of production but land organizations are not occupied with the work and actually the task of propagation and production of canker-resistant potatoes is left more or less to take care of itself.

It is essential, nevertheless, to eliminate all obstacles to the rapid propagation of canker-resistant varieties. All regulations dealing with potato seed growing have to be reexamined to that end and corrected with a view to speed the development of new varieties. Thus, for instance, it is necessary to permit the propagation of prospective canker-resistant varieties, although they have not been regionalized as yet. It is wrong to prevent the development of canker-resistant potato varieties only because some of them happen not to be included in the list of regionalized varieties. It is further necessary to urge selectors, agronomists and collective farmers to speed the selection and propagation of varieties of high yields from among the existing large assortment of canker-resistant varieties in the collections of VIR, VNIISP, IKKH, and other scientific-research institutions dealing with potatoes. The Department of Agriculture of the USSR should solve the problem of legalizing prospective canker-resistant potato varieties in as short a time as possible and permit the production of the elite of these varieties.

THE SUBSTANTIAL SHORTCOMINGS IN SEED GROWING WORK ON POTATOES CONSIST IN: the lack of a preparatory network for canker-resistant varieties of potatoes, the inadequate use of approved varietal potatoes for seed purposes, the inadequate inclusion of all seed plots into approval and incomplete statistics of them, as well as a lack of seed plots in every collective farm.

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Practice has shown that along with the propagation of canker-resistant varieties on a relatively large territory, it is essential that the distribution of these varieties be done in small amounts to advance shock-collective farms for the propagation by speediest methods.

A great omission is the circumstance that in the approval of potatoes compulsory laboratory testing of the purity of the seed potatoes by light sprouts is not made. Technical difficulties were primarily responsible for the fact that this evaluation of the purity of canker-resistant potatoes by light sprouts was not used in the approval of potato sowings. This method of evaluating varietal purity should be given the widest application, since it prevents the raising of seed material which includes a large mixture of other varieties and offers the opportunity to control propagated canker-resistant potato varieties.

All these problems require adequate attention on the part of the Department of Agriculture of the USSR, the respective department of the Union Republics and agricultural administrations of oblasts.

Division of Quarantine for Agricultural Plants, Dept. of Agriculture of the USSR.

End of article

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Declassified and Approved For Release 2013/03/25 : CIA-RDP80R01426R009900010001-5

Declassified and Approved For Release 2013/03/25 : CIA-RDP80R01426R009900010001-5

Gandelman, Ts. S.
Importance of Summer Planting of Potatoes in the Control of Potato Canker
Sad i Ogorod 1950(6):61-64. June 1950. 80 Sal3

Translated from the Russian by
S. N. Monson

R-35

One of the most vivid accomplishments in Michurin agro-biological science with regard to potato growing is the theory developed by the academician T. D. Lysenko which reveals the causes of potato degeneration in the south. On the basis of this theory summer plantings were proposed as one of the means to improve generic qualities and aid the control of degeneration as a disease.

Summer plantings improve the racial (seed) qualities of potato tubers; tubers grown from summer plantings preserve, moreover, their acquired characteristics even in the following year, in size, high yield and resistance to disease. On the basis of a study made under the immediate supervision of the academician T. D. Lysenko at the Central Anti-Canker Laboratory concerning the influence of summer plantings and the subsequent work of Professor N. A. Doroshkin, allegations were made concerning the fact that summer plantings of potatoes can play a significant role as an agricultural measure in controlling dangerous diseases, i.e., potato canker.

Our observation conducted from 1947-1949 showed that under summer plantings the number of infected tubers from potato varieties susceptible to canker was considerably diminished, even on severely infected plots, as was the accumulation of infection in the soil.

The results of the experiments are eloquently illustrated in tests conducted at the station under different soil and climatic conditions on severely

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infected plots of the Chervenski region, of Minsk oblast and the Kalinkovich region, Polesski oblast, Belorussian SSR.

The plots intended for planting were selected in the fall and plowed at that time. In choosing the plots the degree of soil infection by canker was taken into consideration.

Plots plowed in the spring were plowed over again and manure was introduced in the proportion of 40 tons per hectare, the soil harrowed, kept in a friable condition, and free from weeds by steady cultivating.

The seed material of the first two varieties was vernalized (under spread light) in a light, well ventilated dwelling and the remaining varieties in the open air under cover.

Potato tubers of the varieties C-5760 (BELORUSSIAN) and EARLY ROSE were planted at five-day intervals, from May 10 to July 30. The experiment was made in three variants. Tubers planted in the summer of 1948 were planted in 1949 during the same periods and on one spring date, that of May 10. Spring-grown tubers served as control. No attempt was made to select degenerated plants and those of low yield.

In estimating the yield we established that the highest percentage of tubers infected by canker was observed from spring potato plantings and the lowest from summer plantings. The best yield was obtained from the progeny of tubers grown from summer plantings in 1948 and those planted during one spring period in 1949 (Table 1).

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Table 1

POTATO YIELDS DEPENDING UPON PERIODS OF GROWING PLANTING MATERIAL

Periods of Planting in 1949	Total Yield in 1949* in c/h	Yield in % in relation to control
Variety C-5780 (Belorussian)		
May 10	113.6	100 Control
June 10	231.6	203.5
June 20	198.7	175.4
July 5	242.6	213.0
July 15	218.5	192.0
Variety Early Rose		
May 10	117.5	100 Control
June 10	142.8	121.0
June 20	123.6	105.1
July 5	158.0	134.4
July 5	159.7	135.8

*In 1949 the entire potato crop was planted at one time, on May 10.

As seen from Table 1, the yield of the variety EARLY ROSE increased, compared to control, 5-35 per cent, while in the case of the variety C-5780 (BELORUSSIAN) it amounted to 75-113 per cent.

In addition the percentage of healthy tubers also increased.

Infection of clumps and tubers by potato canker was reduced in late plantings (Table 2).

Table 2

DEGREE OF CANKER INFECTION DEPENDING UPON PERIODS OF PLANTING

Periods of Planting	Variety Early Rose Per cent of infection		Variety Seedling 5780 Per cent of infection	
	Clumps	Tubers	Clumps	Tubers
	ON CHERVENSK EXPERIMENTAL PLOT			
May 10	76.71	17.56	-	-
June 20	2.77	0.54	-	-
July 10	0	0	-	-
	ON KALINKOVICH EXPERIMENTAL PLOT			
May 10	48.9	30.4	46.9	41.2
June 20	21.6	5.9	18.8	7.8
July 10	0	0	0	0

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The most interesting data may be observed in comparing infected potato clumps and tubers with those of spring and summer (Table 3).

Table 3

INFLUENCE OF YEAR-OLD SEED POTATOES ON CANKER INFECTION
(KALINKOVICH EXPERIMENTAL PLOT)

Periods of planting in 1949	Periods of planting in 1948	Per cent of Canker Infected Plants	
		Clumps	Tubers
	VARIETY SEEDLING 5789		
June 10	Spring	31.0	15.0
June 10	Summer	20.8	8.3
June 20	Spring	18.9	8.0
June 20	Summer	13.0	5.0
	VARIETY EARLY ROSE		
June 10	Spring	29.4	13.33
June 10	Summer	11.7	8.7
June 20	Spring	21.62	6.0
June 20	Summer	14.8	3.0

The above data indicates that in the second year of training potatoes in summer planting the resistance of susceptible potato varieties to canker was considerably increased compared to those planted in the spring. We further observed that losses in yields from potato canker were much higher in plantings of spring-grown tubers than from summer-grown tubers. For instance, yield losses from Early Rose, when planted June 10 from spring-grown tubers, were 17.3 per cent, while from year-old summer-grown tubers they amounted to 7.6 per cent.

Periods in potato planting are evidently significant because of the accumulation of canker infection in the soil, hence the difference in the degree of infection in plantings. The tests performed in 1949 confirmed that the accumulation of infection is reduced 1 square mile of the area in summer plantings.

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Systematic observations indicate that the development of canker depends upon the age of the plant-host, the period of vegetation and the corresponding soil and climatic conditions. The parasite begins its development most frequently by infecting the sprouts, the awakening buds on stolons and small tubercles; the fungi act differently on different varieties.

Under laboratory conditions, as seen from our observations, the highest degree of infection of susceptible varieties occurs at a temperature of plus 18-20°. Moisture of the soil is of equal importance. The early appearance of the parasite is noted at a degree of 25 to 30 per cent of moisture of soil against full moisture capacity. A higher moisture of the soil contributes to the more intensive propagation of the sporangia of the parasite. By analysing the samples of plants at various age stages in the different periods of vegetation, we observed that from June 10-20 (Belorussian conditions) propagation of the parasite is greatly diminished and its accumulation in the soil thereby also reduced.

Simultaneously with our experiments on infected plots practical experiments were made at collective farms on uninfected soils (by the junior assistant M. I. Korneichuk) at the Dzerzhinsky farm, Minsk region, Minsk oblast, and the Kalinin collective farm, Kalinkovich region, Polesski oblast.

The above experiments indicated that under proper cultivation of the plot, adequate selection of varieties and vernalization of seed material, yields from summer plantings exceed those obtained from spring plantings.

In order to plant potatoes in summer periods collective farms assigned plots in potato fields under crop rotation; these were plowed in the fall. In

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early spring manure was introduced in the proportion of 40 tons per hectare and dug in 23 cm. deep. Prior to planting potatoes in the first two spring periods (May 10-20) the plots were harrowed and rolled (?).

In June the soil began to cake because of abundant rainfall; the plots were therefore plowed over to a depth of 12 cm., followed by harrowing several days prior to planting in the last periods (June 20-30 and July 10). The area of nutrition was 60 x 40 cm. Vernalized potatoes of three varieties were taken for the experiment: the canker resistant variety ZVENIEVOI and two canker susceptible varieties: C-5780 (BELORUSSIAN), medium maturing, and the early maturing EARLY ROSE.

The vernalized tubers were moistened the day of the planting since sprouts dry out under sun and wind and then break off. By using this precaution we succeeded in preserving all sprouts.

In the first two periods of planting it was necessary to harrow twice because the sprouts came up on the 28th and 32nd day.

In summer plantings there was no need to harrow twice, since sprouts came up on the 11th and 12th day.

Prior to harrowing and before the second hilling, additional feeding with complete mineral fertilizers was provided in the proportion of 2.5 centners of super-phosphate, 1.5 centners of potash, and 2 centners of ammonium sulfate per hectare. The potato yield is given on table 4.

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Table 4

POTATO YIELD DEPENDING UPON PERIODS OF PLANTING

Name of collective farm and region	Variety	Period of Planting	Yield in c/h
Dzerzhinski Coll. Farm Minsk oblast	Zvenievoi (canker-resistant)	June 20	220.6
		June 30	182.0
The same	The same	July 10	183.0
The same	The same		
The same	The same		
The same	S-5760 (Belorussian)	June 20	160.0
The same	(susceptible)	June 30	151.2
Kalinin Coll. Farm, Kalinkovich region, Polesk oblast	Early Rose (susceptible)	June 20	210.0
		June 30	195.0

The potato yield of the canker-resistant variety was much larger than that of varieties susceptible to canker.

It will be observed from the above data that one may recommend summer plantings to collective farms not alone for the purpose of improving qualities of potatoes under Belorussia conditions, but also as an agricultural measure for controlling potato canker until such time that entire plots and areas will be planted with canker resistant varieties in focuses of infection and their adjoining territories.

Minsk Scientific-Research Station for Potato Canker.

End of article

2-28-51

Declassified and Approved For Release 2013/03/25 : CIA-RDP80R01426R009900010001-5

Declassified and Approved For Release 2013/03/25 : CIA-RDP80R01426R009900010001-5

Iashchuk, A. P., and Tereshchenko, E. F.
Control of Stem Nematode in Potatoes.
Sad i Ogorod 1950(8)32-34. Aug. 1950.
80 Sal3

R-40

Translated from the Russian by
S. N. Monson

Stem nematodes are a type of worm which, according to its description in literature, is distinguished by an extremely poisonous nature. It acts as a parasite on plants of 120 species and on representatives of over 30 families. Among cultivated plants, aside from potatoes, stem nematodes damage clover, alfalfa, vetch, rye, oats, tobacco, onion, buckwheat, and horse bean, etc.

Nematodes injure the stems, leaves, tubers and bulbs of plants; they spend part of the year in the soil, and propagate within the plant. Dry and cold weather contribute to the destruction of the nematodes, while damp and warm weather favor their spread. The greatest damage to potatoes is caused by nematodes in rainy years, when high precipitation falls into the second part of summer.

Dark-grey and brown spots, resembling phytophthora, appear on diseased tubers; the skin becomes detached in the majority of cases and the tubers become focuses for the decay of potatoes in storage. Nematodes injure tubers under clumps in the field which then serve as focuses of different bacterial diseases, this circumstance adversely affecting the keeping quality of potatoes and increasing storage losses.

Under conditions of the Ukrainian SSR damage caused by nematodes may in some years be compared to that of phytophthora.

In spite of the wide distribution of stem nematode, it is not sufficiently known among agricultural specialists, although the damage caused by this pest to potato growing is felt more strongly from year to year.

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It is regrettable that handbooks on potato growing devote little attention to this disease and that popular literature does not make any reference to nematodes. It is not surprising therefore that it is frequently confused with other diseases, attributed to phytophthora or dry rot, or even listed among "other" diseases. Nor does it appear sensible that the instructions of the Ministry of Agriculture of the USSR, pertaining to production of high quality potatoes and the establishment of standards for varietal seed potatoes do not mention injuries caused to tubers by stem nematodes.

Surveys of plantings conducted in 1938 and 1939 indicated that stem nematode is spread in all Ukrainian oblasts, the degree of tuber injury varying between 1.5 to 4 per cent. In recent years the damage caused by the pest has considerably increased. When artificially infected early varieties react more severely than late and medium maturing varieties. Among late maturing varieties, Parnassia and Wohltman are relatively resistant.

The biology of stem nematode has not been sufficiently studied. As stated above, nematodes have been classified as highly poisonous parasites, but the possibility of the transmittance of the parasite from potatoes to other crops and vice versa remains unexplained.

Our observations indicate that the soil under crop rotation does not serve as a focus of potato infection. Studies made of the degree of infection among different potato varieties under field conditions and by artificial infection convince us that the main role of distributor of the disease is played by the seed tuber stock. In order to save seed material from infection we engaged in the study of different mordants for a period of four years, i.e., calcium polysulfide (?), formalin, calcium hypochloride mixture, superphosphate, Ceresan,

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DDT, and hexachloran. Some mordants (super-phosphate, DDT and hexachloran) contributed to a reduction in the percentage of decayed tubers, but this reduction was so insignificant that it is not possible to recommend treatment with mordants as an effective means of controlling nematodes.

Analysis has established that the later the date potatoes were gathered, the greater was the number of tubers infected by nematodes. To confirm this we shall present average data for 1948 and 1949 concerning the infection of tubers of the variety Ostbote, in connection with different periods of harvesting (Table 1).

Table 1

Date of Harvesting	Tubers infected with stem nematodes - in %
July 6 and 26	0
August 5	Individual tubers
September 13	24

Our tests proved that tubers of early harvests were less infected by rhizoctonia, scab and pests, and that their progeny showed a small percentage of degenerated plants. The station is therefore each year selecting and gathering for their elite stocks clusters before the potato foliage dies. An analysis of harvests of tubers of the same variety but of different periods of planting indicates that the percentage of infected tubers is reduced during late planting and that the yield of tubers from summer plantings is practically immune to nematodes.

Data on tuber infection of the variety Ostbote by stem nematods together with dates of planting is listed in Table 2.

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Table 2

Dates of Planting	Percentage of Tubers Infected by Nematodes 1948	1949	Average figures for 2 yrs.
Spring	26.0	48.0	37.0
June 15	16.2	16.0	16.1
July 1	2.5	6.0	4.2
July 6	0.0	2.0	1.0

In experiments conducted in 1949 by G. N. Linnik at the Kharkov Station identical results were obtained.

As indicated above, stem nematode spreads through seed material and every effort should consequently be directed to obtain seed tubers free of nematodes. Experience has shown that the growing of seed potatoes from summer plantings is one of the safest ways to control nematodes. The results of the experiments conducted on farm plots have fully confirmed this.

In 1949 an experiment was begun on the relative study of different methods of controlling nematodes (Table 3).

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Table 3

Variants of Experiment	Yield in c/h	Percentage of clumps infected by nematodes
Planting with Tubers:		
From fall selection of every cluster (clusters not infected by nematodes were selected)	385	1.2
Fall selection of group of potatoes infected by nematodes	352	2.5
Spring selection of group of potatoes infected by nematodes	331	42.0
Harvested in the first part of August	349	9.2
Harvested after the foliage died	330	55.0
From summer plantings	373	6.3
Planting with tops of apparently non-infected tubers	319	14.5
Planting with stolon part of these tubers	296	38.0

Data of former years and that of the present experiment convince us that even the most careful selection of tubers made in the spring from an infected group of potatoes does not ensure a harvest free from nematodes. Apparently, nematodes in wintering in storage, when in contact with infected and healthy tubers infect the latter, and in the first stage of infection it is not possible to distinguish diseased from healthy tubers by eyesight.

In the control of stem nematodes first place should be assigned to the selection in the fall of clusters and tubers not infected by nematodes.

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The planting of tubers from early harvests and summer plantings drastically reduces the percentage in yield of tubers free from nematodes. By eliminating the infected clumps of summer plantings and by early harvesting, every farm is able to get rid of stem nematodes completely in the course of one or two years and secure healthy seed stock.

End of article

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R-412

Kirienko, M. V.
Infection of Potato with Armillaria mellea. Priroda 38 (7): 59-60. July 1949. 410 P933

Translated from the Russian by
S. N. Monson

In the fall of 1948, during the harvesting of potatoes in garden plots belonging to the employees of the Polesski Scientific-Research Station of Field Industry (Zhitomir oblast), it was observed that individual tubers and frequently entire nests of tubers there were covered with Armillaria mellea (Vahl) Quel'. which, as is known, are most frequently found on roots and especially stumps of woody trees.

The rhizomorph enveloped the tubers in the shape of stringlike black strands, of a length of 0.5 m and over, and a thickness of 2 mm. In places where the branches were closely joined, the rhizomorph grow into the skin of the tubers, causing the skin to swell and even burst. This enables one to observe the dark brown strands. (see ill.) The tissue of the tubers slightly changes its normal color and gradually takes on a yellowish and dirty-whitish color and a spongy consistency. As a final result the potato tubers rot.

This fact had already been observed in Leningrad in 1943 and was described in detail by A. S. Bondartsev (Soviet Botany, No. 5, p. 28, 1945).

His article, however, does not indicate that the potatoes, diseased as a result of the rhizomorph, acquired phosphorescence, i.e. the ability to produce a weak blue light, well noticeable in the dark until such time that the tubers dry out.

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It is interesting to note that as was established the infection of tubers was observed not only on those garden lots situated in coniferous forests, on recently cut ground, but also on a field, located at a distance of 1.5 km from the forest where the trees had been cut down many years ago and where only separate stumps and a few shrubs had remained.

It follows therefore that lots assigned for potato growing should be carefully uprooted and cleaned of shrubs and woody remainders. These plots should also be used for some other crop during the first year and not for potato growing.

End of Article

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Korotkova, P. I.
Resistance of Potato Varieties to Black Leg.
Selek. i Semen 14(10):58-63. Oct. 1947. 61.9 Se5

R-47

Translated from the Russian by
S. N. Monson

The problem of resistance of potato varieties to black leg disease has not been adequately studied in our literature. We know of only one work on the subject, that written by V. P. Izrailskii and E. V. Runov.

Both authors, using the laboratory method, attempted to establish the resistance of potato varieties to black leg by the rapidity with which inoculated slices of potatoes decayed. According to their data, the varieties ZNICH, SWEETEZ and GRACIA possessed greatest resistance, while the varieties IMPERATOR, RICHTER and SHESTINEDELNY (Six-Weeks) were considered by them susceptible to the disease.

In 1933 we organized our project at the Leningrad Zonal Potato Station, the object of which was to determine the resistance of potato varieties to black leg disease. In planning the outline of the work we aimed to cover as widely as possible the available assortment of potatoes at the station, i.e., all cultivated varieties, as well as South American forms.

In order to conduct the work on such a large scale a method of mass inoculation of plants had to be applied, which if easily and rapidly used, would produce satisfactory results.

We were not satisfied with the methods of inoculation described in previous literature, both domestic and foreign, since in examining it we found that a considerable part of plants grown from infected tubers remained healthy and that, moreover, the success in inoculation depended upon the virulence of selected

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bacteria into pure culture, the activity of which varies from year to year. To judge plant resistance on the basis of the rapidity with which potato slices decay appeared to us not to be the proper method. We believed that the process of tuber decay in the soil, under field conditions, may proceed differently from that in the laboratory. In addition, we had come to the conclusion that the resistance of a variety will, first of all, depend upon the susceptibility of the stems to infection. No matter how long it took for the maternal tuber to decay under the influence of introduced infection, the appearance of black leg on the plant fully depended upon the penetration of the disease into the STEMS. The stronger the resistance of the stems, the higher was the resistance of the variety. The rapidity with which tubers decay will be of significance only for the duration of the vegetative period. Varieties showing tuber resistance will possess a longer incubation period, i.e., black leg disease will make its appearance at a later date but the degree of infection will be high just the same.

We shall consequently dwell in our work upon the method of stem inoculation. Following a series of studies, we worked out and accepted the following method of inoculation: During the budding stage a small (0.5 cm.) cut was made with a scalpel on the bare "root neck" of plants and a gruel (?) of diseased stem tissue (black leg) was introduced into the wound; the mixture was ground with a pestle and combined with distilled water. The plants were lightly hilled after inoculation, and if the ground had been dry, were watered the same day. Non-resistant varieties became rather quickly infected by this method and produced typical symptoms of black leg disease. If the inoculation was done later, towards the end of the blooming period, the sensitivity of the stems decreased considerably and the number of diseased plants was much smaller. If inoculation was applied

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to the central part of the stem it developed only a localized disease, non- typical for black leg, nor was there any infection of leaves in that case.

Diseased tissue was used in place of pure culture because the virulence of segregated bacteria varies from year to year. Thus the pure culture Erwinia Phytophthora which we segregated in 1933, proved much more active than that of 1934. In order to compare both methods, we infected the same varieties with pure culture of bacteria and with the mush of diseased tissue. In 1933 both methods produced identical results, i.e. of 48 tested varieties deviations were obtained only in two cases.

In the following year, 1934, the inoculation with pure bacterial culture resulted in a much more limited quantity (number of diseased plants), and the degree of appearance of the disease was less striking. We, therefore, determined to apply the method of inoculation with diseased tissue, as one that was simpler and still produced [illegible] results.

In order to determine the resistance of a plot, each variety was planted in quantities of 5 to 10 tubers. Two to three well developed stems of each cluster were infected. The succeeding work consisted in daily observation and watching for the appearance of symptoms of black leg.

The estimation of the degree of infection was made by a three mark system: plants of which the stems decayed rapidly were marked "3", those where the process was delayed and did not spread upon the entire stem were marked "2", and plants which did not show any symptoms of infection, except for a light browning within the stems, extending from the inoculated place were marked "1". The latter condition could be established only during harvesting by splitting the stems lengthwise.

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The incubation period of the first two groups (rated 2 and 3) was determined from the moment of infection to the beginning of the appearance of symptoms characteristic of black leg disease (chlorosis, leaf roll, etc.). For varieties belonging to group 3 (rated 1), the incubation period was figured from the moment infection was introduced to harvesting time, i.e. when the stems were split so that the results of the infection could be seen. The estimate of the degree of infection and the determination of the duration of the incubation period were conducted separately for each plant and later the average estimated for the entire variety.

In order to test the permanency of symptoms of resistance, some varieties were infected for two successive years. This established that they corresponded in degree of infection and length of incubation period. Thus, varieties which in 1934 were considered non-resistant, received the same rating during the repeated test in 1935. As to the duration of the incubation period, it could vary depending upon meteorological conditions. Thus, for the variety Epicure it equalled 20 days in 1934, and only 11 days in 1935, a year of higher moisture. In spite of these variations the relative length of the incubation period for varieties proved fairly constant.

The characteristic measure of varietal resistance was based by us upon the following: varieties rated 2 and 3 belonged to the group of non-resistant varieties, irrespective of whether they had a long incubation period. These varieties, in spite of the late appearance of the disease, were still capable of infecting seed material in the field (daughter tubers) by penetration of bacteria into young tubers through stolons and the contact of tubers with diseased, decayed foliage. The difference between these varieties and those where infection took place more rapidly consisted in the late appearance of black leg (closer to harvesting), but all yield was always contaminated.

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Varieties rated "1" and distinguished only by a light browning of the inner part of stems, and having a lengthy incubation period, may be considered practically resistant. Seed material of these varieties is free of black leg contamination.

Our plan for testing varieties for resistance to black leg disease followed this procedure: in the first year 5 to 10 tubers of a variety that had been rated 2 to 3 were treated and rejected, and those varieties that belonged to group III, or did not show typical symptoms of the disease were left for a repeated test.

In the second year of testing the number of infected plants was increased to 30. In the third year only those varieties remained that had proved resistant in the first two years of experimentation. The number of tested plants amounted to 50. Usually the main mass of varieties was eliminated already after the first year and by the end of the second year only individual varieties were left. Thus in the first year of our work, we rejected because of non-resistance, approximately 90 percent of all cultivated plants available for tests. Towards the end of the third year there were left no more than four or five varieties.

According to the plan of the work, if any variety for whatever reason got into the resistant group, this factor was eliminated in the repeated test, particularly because the number of infected plants increased from year to year. The early stage of experimental work was performed in the field, and the varieties which did not get infected in the course of three years were subsequently submitted to additional testing in nurseries under conditions of increased moisture and temperature.

As a result of five years' work, we managed to rate all cultivated potato and South-American varieties available at the Leningrad Potato Station, totalling

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2,000 specimens. In addition, the resistance of many inter-species hybrids was tested.

Table 1

POTATO VARIETIES SEVERELY INFECTED

Nos.	Name of Variety	Rating	Length of Incubation Period (in days)
1	Epicure.....	3.0	15.0
2	Wohltman.....	3.0	16.0
3	Cobbler.....	2.6	26.0
4	Belladonna.....	3.0	27.2
5	Early Rose.....	2.6	36.4
6	Great Scott.....	2.8	32.5
7	Epron.....	3.0	21.0
8	Majestic.....	2.6	39.4
9	Silesia.....	2.0	27.2
10	Lorkh.....	2.6	29.7

Table 2

POTATO VARIETIES MODERATELY INFECTED

Nos.	Name of Variety	Rating	Length of Incubation Period (in days)
1	Centifolia	1.6	39.3
2	Korenevskii	1.6	37.4
3	Smyslovskii	1.6	36.2
4	Jubel	1.4	49.0
5	Rudzinskii	1.5	38.5

Table 3

POTATO VARIETIES LIGHTLY INFECTED

Nos.	Name of Variety	Rating	Length of Incubation Period (in days)
1	Lobelia	1.1	48.0
2	S. Buzola	1.0	50.0
3	Nestor	1.2	46.5
4	Gracia	1.2	48.0
5	Neu Daber	1.2	46.3
6	Magnolia	1.3	47.0

It appeared that cultivated varieties were in the majority of cases nonresistant

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to black leg; the degree of their contamination rated from 2 to 3 and the period of incubation was usually brief. A limited number of varieties showing resistance under field conditions (Nestor, Gracia, Kobelia, S. Buzola, etc.) lost this characteristic when infected in the nursery. This speaks for the fact that they will be resistant in ordinary years but will get infected in moist and warm years.

It was further observed that some lines among cultivated varieties were particularly susceptible to the disease, producing a severe case of infection of black leg in almost all varieties belonging to that particular line. Our observations numbered among these lines the variety Early Rose, Epicure, Victoria Paterson. Other lines, while also susceptible to black leg, produce several resistant varieties, such as the group of Daber potatoes: Nestor, Gracia, Neu Daber. We shall limit ourselves in this article only to statements concerning those tested varieties distributed in one form or other in our domestic production (tables 1, 2, and 3.)

Among South American species there are many resistant forms, the rating of which does not exceed "1". Only one immune variety was discovered, Tarmense Latior 8118.

FORMS FROM S. TUBEROSUM SEVERELY INFECTED

Nos.	Name of Variety	Rating	Length of Incubation Period (in days)
1	Pallidium 244.....	3.0	49.0
2	Oculosum 258.....	2.5	49.0
3	Villa Hermosa 381...	2.0	44.2
4	Cebolia 240.....	2.0	46.2
	Form S. andigenum		
5	Lapazense 186.....	2.2	26.0
6	Globosum 185.....	1.8	43.4

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FORMS LIGHTLY INFECTED

Nos.	Name of Variety	Rating	Length of Incubation Period (in days)
1	S. Rybinni.....	0.7	50
2	S. phyreja 11/1810...	0.7	50
3	S. andigenum f. tocanum 49/49-a.....	0.8	50
4	S. chilotanum f. indianum.....	0.5	50
5	S. Acaule 825/147-A..	0.4	50

Tests of the resistance of hybrids indicated that their susceptibility to black leg is closely connected with the susceptibility shown by their parents. If parents belonged to groups I and II in degree of their susceptibility, then the progeny was, as a rule, also severely susceptible. Whenever one parent proved resistant, the hybrids showed a mixed picture with regard to susceptibility; one part was resistant, the other susceptible. Thus, almost all combinations in which Epicure participated proved severely susceptible and only in a crossing with S. Rybinii was one part of the seedlings placed in group III.

Among the combinations worth mentioning are:

1. Centifolia X S Rybinii
2. Centifolia X Curtilobum
3. S. Andigenum f. tocanum X Colombia X Centifolia.

All these hybrids, 40 in number, showed a susceptibility no higher than "1". Among the severely non-resistant combinations are: Furstenkrone X Federi-Segmentatum, the former being taken both as a maternal and paternal plant.

Of 14 numbers, 13 proved non-resistant.

We also observed that varieties with coarse, hard stems were more resistant

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than those having succulent stems, containing much water. This circumstance may explain the resistance of South-American forms of potatoes, as compared to cultivated varieties.

As indicated above, plants lose their sensitivity to disease with age, which is also connected with the depletion of water, with their growing woody. In conclusion we wish to note that we failed to disclose any connection between resistance and such varietal characteristics as early maturing, starch content and others. Varieties, such as Wohltmann, Early Rose, Epicure, which differ radically from each other, all belong to one severely infected group in susceptibility to black leg disease.

CONCLUSIONS

1. The introduction of the infection of black leg into the root necks of plants in the budding stage is more suitable than are other methods for determining resistance.

2. The substitution of pure culture of the Bacillus phytophthorus Ap. by diseased plant tissue, prepared from recently diseased potato stems, ground into a gruel (?) and combined with distilled water, simplifies considerably the procedure of artificial inoculation and at the same time heightens its effectiveness.

3. Cultivated varieties are in the majority of cases severely susceptible to black leg infection, rate high in degree of infection and have a short incubation period.

4. South-American potato forms are resistant to black leg in the majority of cases. Only one immune variety was discovered among South American forms - Tarmense Latior 8118.

5. Resistance in hybrids depends upon the presence of this characteristic

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in the parent forms. Inter-species crossing of cultivated varieties with resistant South American forms produces a large number of resistant seedlings.

On the basis of the above, we consider that the production of potato varieties, practically resistant to black leg, is fully possible.

Kazan Government Selection Station.

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